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ON THE SUBJECTS OF

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No 66 N Calvert St.

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ON THE

RECIPROCAL AGENCIES OF MIND AND MATTER,

Being the Lumleian Lectures for 1851,

BY J. C. BADELEY, M.D., CANTAB.

LECTURE I.

Preliminary observations—Exposition of the theories of philosophers—Explanation of the agency of the mind—Close analogy of the nervous and electric fluids—Effects of atmospheric electricity on the human system—Distress of mind the cause of cancer—Opinions of Sir Astley Cooper and Sir B. Brodie—Nervous affections—Illustration of their action—Hysteria—Gout—Theory of gout—Temperament—Influence of the sanguine temperament—Anecdotes illustrative of the fatal power of the mind—Hope—its action—Hypochondriasis—Theory of dyspepsia, and its operations on the temper and disposition—Instances of uncontrolled anger—John Hunter—Sleep—theory of, operation of—Dreaming—Nightmare—Delirium—Somnambulism—Suicide—Epilepsy—Apoplexy—Paralysis—Instances of the power of the mind—Fear—Grief—Joy—Chloroform—Narcotics—Opium—their agency—Alcohol—Fainting.

Mr. President and Gentlemen,—In entering on the office of Lumleian lecturer, which I have the honour of holding, and in offering the product of my humble experience to so learned a body, some little allowance will, I trust, be made for the many imperfections which I am but too well aware are inseparable from my position. The science of medicine has, within the last few years, advanced with strides so rapid, and improvements so unquestionable—whilst treatises so luminous and voluminous, in every department of science, have been launched so liberally from the press—that the selection of a subject for a lecture is as difficult as the prospect of throwing new light upon it is comparatively hopeless. An expansive veil of obscurity, nevertheless, still shrouds the arcana of nature and of disease; and many are the objects which neither the mental acumen of man, nor the telescope of time, will probably be ever able to explain. We witness disease in myriad forms and varieties, and are hourly invoked to obviate its ravages; and we succeed: we employ the remedies which science has supplied, and experience has attuned to their complicated operations: we snatch, in numberless instances, the sufferer from an untimely grave; or, if we fail in averting a fatal termination,—

> "Make languor smile, and smooth the bed of death."

Not entirely discouraged, therefore, by the difficulties with which it is encompassed, I have selected for my subject, in the performance of the duties which are assigned me, *The Reciprocal Agencies of Mind and Matter;* and, inasmuch as no part or portion of the body is exempt from mental operations, and, on the other hand, the functions of the mind are either impaired or obliterated by diseases of the Encephalon, a most extensive and interesting field is open before us. Such, indeed, is the varying intensity with which the mind operates directly or indirectly on our corporeal structure, that at one time it prostrates, and in a moment extinguishes every manifestation of life—at another, it paralyzes, or only partially destroys it: or it lays the lamentable foundation of protracted and incurable disease. Knowing, as we do, that the brain is the seat of the acknowledged superiority of man over the whole of animated existence—the fountain from the which our every passion and our every feeling flows—the abode of consciousness—the throne of intellect—of reason—of memory—of judgment—in a word, of every manifestation of the human mind—it becomes our duty to study its material conditions in connection with disease, as well as to trace out and observe the mental phenomena dependent on its impairment. It is not my intention, however, to wander into the mystical labyrinth of metaphysical inquiry, nor to subject myself to the animadversions of theologians by advancing doctrines to which any objection can be raised. A broad margin exists between the *Animus* and the *Anima.* The workings of the one (inasmuch as they are connected with, or dependent on the brain and nervous system) come legitimately within the province of the physician, and may fairly be discussed without entrenching on the object of the care and cure of the divine; and far be it from me to invade his holy mission, or trespass on the boundary of his pious office! Undisputed as it is by men endowed with reasoning faculties, and not afraid to exercise them, that the brain is the material organ of the mind—established as the proposition is by positive, and strengthened as it is by negative reasoning—we have *no choice* but to believe it: hourly evidence demonstrates it; and, to shrink from the contemplation of its workings, or to reject the fact itself, is to mistrust the wisdom and deny the Omnipotence of Him who created and endowed it! Not that the identity of mind and matter is hence to be inferred—the "πνευματα" of Galen are as distinct from the brain itself as the πνευματα, or atmospheric gales, which elicit sound from the Œolian harp, are distinct from the harp itself. "The wind bloweth where it listeth, and no man can tell whence it cometh, or whither it goeth." Should the brain be disordered, as is evinced in the delirium of fever, or should its structure be impaired, as in cases of insanity, the healthy action of the mind is impaired or obliterated also; and, should the harp be out of order, or its strings be out of tune, its music is discordant, its melody destroyed, or no sound whatever can be elicited from it. The brain being the seat of consciousness and of perception, objects act upon it, exciting different emotions and sensations, which are conveyed, through the medium of the nerves, to different organs of the body—to the glands, for example, whereby the secretions are instantly affected. What, in common parlance, is the "mouth-watering," but the sight and anticipation of a savoury morsel acting through the brain and nerves on the salivary glands, augmenting their secretion, and otherwise preparing the digestive apparatus for the exercise of its function? What are tears, but the liquid essence of grief or joy emanating from the action of the mind on the lachrymal glands, under the influence of mental emotion? What is the palpitation of the heart and tremor of the muscles, in cases of sudden and strong excitement, but the action of the mind on the muscular fibre, and consequently on the circulating system, through the medium of the nerves? And so on with other functions of the animal economy which it is unnecessary to enumerate. That these effects *are* produced, and these sensations generated, is known by daily and hourly experience to every one; but to demonstrate *how* it is effected, "*Hic labor, hoc opus.*" The subject, at all events, has given birth to many shrewd conjectures—to many ingenious theories—to great varieties of opinion, and to much profound reasoning amongst philosophers, from the time of Hippocrates to the present day. Haller, who has examined these respective theories most minutely, leans to the opinion that the *modus operandi* of the nerves is by means of a most subtle fluid permeating their cavities, and to which the name of "*Spirit*" was given. This is, in fact, the "*Arachæus*" of Van Helmont, the "*Anima*" of Stahl, the "Πνευμα" of Galen, the "*Materia vitæ diffusa*" of Hunter, the "*Vital principle*" or "*Subtle essence*" of others, all of which are, in fact, synonymous. Hunter conceived that this mobile, invisible spirit, was superadded to inert matter, as magnetism is to iron, and put in motion other bodies which are evident to the senses; that it is consequently analogous to electricity and magnetism, though not identical, and is so beautifully described in the 6th Æneid of Virgil.

As to the "vibrations and vibratiuncles" of Hartley, whether of an elastic ether, or of the infinitesimal particles of the brain and nerves, "there *may* be such things" (as Dr. Reid says) "for what we know, and men may rationally inquire whether they can find any evidence of their existence; but, while we have no proof of their existence, to apply them to the solution of phenomena, and to build a system upon them, is what I conceive we call building a castle in the air." It is true that Sir Isaac Newton formed a conjecture of this nature, an authority which would seem to give it a firmer foundation; but he admitted also that it was not established by proof, though it was entitled to be examined by experiments. Hartley, however, referred all our sensations and ideas—in a word, all the operations of our minds—to this theory of Vibration—a theory which is opposed and ridiculed by Stewart, Reid, and Drummond. Descartes has attempted almost to demonstrate how, by the animal spirits going and returning in the nerves, muscular motion, perception, memory, and imagination are affected. Some anatomists reject these ideas on the assertion that the nerves are not tubular! Others assert that they are! Le Gallois believed that there is a secretion in the nerves by which their power is transmitted, and through which medium the brain and spinal marrow exercise their action throughout the body. Then, again, there is a sect of *Idealists*, of which Bishop Berkeley and Hume were the leaders: Berkeley, indeed, so warmly embraced his vapid theory of ideas and perceptions, as to reject the very existence of matter altogether! But, as Lord Byron observed,—

> "When Bishop Berkeley said 'There was no matter,'
> And proved it—'twas no matter what he said!"

The only other theory which I shall adduce, and that to which, in my opinion, the greatest plausibility attaches, is, that the nervous influence depends mainly on some modification of galvanism and electricity; and it is an equally curious and corroborative fact, that substances which conduct electricity are also conductors of the nervous fluid, and *vice versâ*. A strong instance of animal electricity presents itself in the Gymnotus, or electrical eel, which it is sufficient that I should name, without detailing its well-known properties.

This is a favourite hypothesis with many able physiologists, as well as with myself, and a close comparison of their agencies substantiates the closeness of their analogy. The experiments instituted by Dr. Wilson Philip, of dividing the nerves supplying the stomach and respiratory organs, and then substituting their suspended functions by a stream of galvanism, still further confirm tho doctrine, and so vividly illustrate its probability, as to place all others comparatively in the shade. The nerves are, in short, the electric wires by which the brain telegraphs its workings to different glandular stations, or issues its commands to the muscles of volition! If those wires are severed, the telegraph works in vain; if those nerves are divided, the operations of the mind on the respective organismus are annihilated also. Dr. Philip, after detailing his experiments, asks—"Is it possible to explain the result of these experiments without admitting the identity of the nervous fluid and galvanism? We must either admit this, or that there is another power capable of performing the most characteristic and complicated functions of the nervous system." Dr. Cooke favours the same opinion. Mr. Walker, in his work on Philosophy, says—"If a person stand on the electric stool with glass feet, and touch the prime conductor for a few minutes while the machine is working, his pulse will be greatly accelerated; and if bled in that situation, the blood will be projected a considerable distance,—showing that electricity stimulates the motion of the heart, and increases the motion of fluids. Can any doubt remain" (he asks) "that this wonderful agent is a prime instrument in muscular motion?" The perpetual variations of our feelings and spirits, without any assignable cause, are, I have no doubt, frequently produced by the varying proportions of electricity in the atmosphere, exerting an influence on the brain and nerves through the medium of our respiratory organs; and it is highly probable that the vital energy common to all animals and vegetables is dependent on the agency of electricity, though perhaps not identical with it. Mr. Smee, in his Treatise on Instinct and Reason, says—"A gentleman who has much to do with various persons as an agent, assured me that the weather much influenced the action of people, and to such an extent was he practically acquainted with it, that he never went out to canvass on a dark and and gloomy day; but when the sun shines, and the sky is bright, people feel happy within themselves, and then he can do business with them?" (p. 250.)

In damp and hazy weather, when electricity is carried off from our bodies by humidity, our spirits become languid, and our sensibility less acute—the nerves lose their tension and elasticity; whereas, on high mountains, spontaneous flashes have been seen to be darted from the fingers, the body containing more than the surrounding rarefied and conducting air.

I am corroborated in this my opinion, also, by Dr. Holland, who says—"Little though its influence has yet been defined, I believe that the electrical state of the atmosphere is that of all its conditions which has most important and diffused effects on the animal economy, more rapid and pervading than any other, and (as one of the vital stimuli) more intimately allied to the functions of the nervous system," (Notes and Reflections, p. 485.) It is difficult to advert to the effects of atmospheric electricity on the body without noticing the question whether this great natural agent is not of itself directly engaged in the functions of the nervous system. It is obvious that changes of atmospheric electricity have much influence on the sensations and voluntary powers, producing results variously analogous to those which attend certain morbid states of body more familiar to us. An atmosphere highly charged with electricity produces alternations of chill and warmth on the skin, and many indescribable sensations; sometimes feelings of a rheumatic character in the muscles, tingling and itching of the sentient extremities of the nerves; and a thunder cloud is frequently productive of headache or other cerebral affections. All this demonstrates the influence of electricity on the animal economy.

But, to return from this digression.

If the mind possesses, through the medium of the brain and nerves, such an immense and powerful influence on the subordinate corporeal organization as to enable man, under the excitement of mental emotion, to perform the astounding feats, and accomplish the Herculean labours which we continually witness or read, it can easily be understood that it can also impair or totally subvert the frail and delicate elements of which our corporeal frame is composed. Thus it happens that by its stimulus to the circulating system, the action of the heart and arteries is impelled at times beyond their powers of endurance; and a vessel bursting on the brain, a fatal apoplexy suddenly ensues, or a lingering paralysis is entailed for probably a melancholy series of years. The body succumbs to the sovereign influence of the mind; and the hero, whose "very name struck terror to the foe," is at once reduced to a state of helpless impotence.

In others, where, through misfortune or through grief, the spirits, once so buoyant, are utterly dejected and depressed, the canker-worm of care, with slow and insidious progress, eats into some less vital organ, and, altering its structure and vitiating its faculties, gradually undermines the fabric of the constitution, and establishes a painful, an incurable, and ultimately a fatal disease.

During the few years in which I formerly practised in London, whilst engaged one morning in conversation with the late Sir Astley Cooper in his study, a patient was announced who had come from Norfolk for that justly eminent surgeon's opinion and advice. His keen and practised eye at once discerned the malady; and before he put a question to the elderly and melancholy object that had entered the room, Sir Astley asked me if I could name his disease? I admitted my inability beyond that of a constitution thoroughly impaired; on which Sir Astley said that he was much mistaken if the poor man was not suffering from carcinoma of the rectum, and that probably his mind was ill at ease. On examining the patient the accuracy of his diagnosis was most fully confirmed. He then observed how frequently that disease ensued on mental distress.

The disease is, however, by no means confined to the rectum. The female breast and the uterus are particularly subject to scirrhus from the same cause.

"I should have observed," says Sir Astley Cooper in his lectures, when speaking of the causes of this disease, "that one of the most frequent is grief or anxiety of mind. It arrests the progress of secretion, produces irritative fever, and becomes the forerunner of scirrhous tubercle. How often have I found" (he continues) "when a mother has been watching, night after night, with anxious solicitude, the pangs and sufferings of her child, and has had the comfort and gratification of seeing its recovery, that in a short time after this she has come to me with an uneasiness of the breast, which on examination I have discovered to be scirrhous tubercle. Full three-fourths of these cases arise from grief and anxiety of mind. It is the state of mind and body which predisposes to this disease. The mind acts on the body, the secretions are arrested, and the result is the formation of scirrhus. Look, then, in this complaint, not only at altering the state of the constitution, but *relieve the mind*, and remove, if possible, the anxiety under which the patient labours."

Most surgeons, I believe, concur in this opinion. Some, however, consider that there must be an hereditary or constitutional predisposition to the disease. Others, that it belongs especially to maidens, or to women who have never borne children. Its visitations, however, occur indiscriminately; and where the exciting cause is sufficiently strong to generate the disease at once in a diathesis favourable to it, a similar result, though more remote, may ensue where it may not be expected. Leaving, however, the subject of cancer (which, it must be admitted, is a strong illustration of the morbid consequence of mental sorrow) yet still adhering to the depression of spirits as a fertile source of bodily suffering, we embark at once on the wide ocean of Nervous Diseases.

Here again the softer and more susceptible sex are, as it is well known, the peculiar victims; for their sensibilities being more refined—their habits (especially in the aristocratic circle of society) far more sedentary—whilst their minds are less briskly engaged—the influence of nervous irritability is more intensely felt, and more permanently engrafted, than in man. Their passions, moreover, being as strong, or perhaps stronger than in man, but covered by that mantle of concealment which Nature, hand in hand with feminine modesty, throws over them, the inward fire keeps slowly smouldering on, and secretly consuming the frail tenement in which it lies imbedded—they become the prey of grief and disappointment; robbing them of

"Tired Nature's sweet restorer, balmy sleep"

—destroying their appetite for food, and their enjoyment of pleasure—absorbing their every thought—disturbing their secretions—and thus undermining their general health, and, perhaps, ultimately sapping even the citadel of Reason itself! So Virgil, speaking of Dido, says:—

"At Regina gravi jamdudum saucia curâ
Vulnus alit venis, et cæco carpitur igne
Multa viri virtus animo, multusque recursat
Gentis honos—hærent infixi pectore vultus,
Verbaque—nec placidam membris dat cura quietem."

Hence arises Hysteria in its myriad fantastic shapes, acting on and agitating different parts, and simulating sundry structural affections so insidiously as to endanger the diagnosis even of experienced physicians. The irritable breast described by Sir Astley Cooper, the hysterical joint and other local affections, delineated so well by Sir B. Brodie, are striking illustrations of it; and it is distressing to think and to know that even limbs have been amputated, and painful operations performed, under an erroneous and simulated impression of the existence of organic disease. To quote the latter talented surgeon's (Sir Benjamin Brodie) own words:—"I do not hesitate to declare that among the higher classes of society at least four-fifths of the female patients who are commonly supposed to labour under diseases of the joints, labour under hysteria, and nothing else," (Lectures, p. 37.) These diseases occur in persons of an irritable disposition and nervous temperament, in whom there is excessive excitability, accompanied with diminished power. The catamenia are almost always irregular, and generally deficient; and this whole class of disease is, probably, in the majority of instances, the reverberations of disappointed Nature on the nervous system. The mind acting on the body through the great sympathetic nerve, affects different parts and different structures, varying in intensity, in form, and in duration, in proportion to the varying sensibilities of its victims. Hence the extensive catalogue of what are designated *hysteric* affections, deriving their name (as the etymology indicates) from that focus of excitement to which my theory alludes. "Sed nec spectabilior est hujus morbi frequentia," says Sydenham, "quam varietas illa multiformis, qua se ostendit, et nullos ferè non emulatur ex iis affectibus quibus atteruntur miseri mortales. Quamcunque enim corporis partem insederit, symptomata (qualia ei competunt parti) statim producit, et nisi medicus tam sagaci quâdam solertiâ et δεινοτητι quam in arte peritia valeat, fraus ei fiet, atque ista symptomata à morbo aliquo essentiali hujus vel illius partis, non verò ab affectione hystericâ, pendere arbitrabitur."

Though corroborating my purpose, it would consume an unnecessary portion of time were I to adduce all the extraordinary and protean forms in which hysteria manifests itself. Suffice it to say, that, contingent as the malady is on persons of high nervous excitability, attended with diminished power, it is best obviated by that class of medicine, and met by that line of treatment, which calms the one and renovates the other; and the medicines and treatment must be adapted to the particular form in which it presents itself, and to the individual circumstances of the person so affected.

Albeit, however, the female sex is more especially the subject of this disease, the etymology of which, as I just observed, would clearly *confine* it to WOMAN, many are the instances in which men are also visited by it, inasmuch as it is an affection of the nervous, as well as of the uterine system. "Quinimo," as that patriarch of medicine just quoted observes, "non pauci ex iis *viris* qui vitam degentes solitariam, chartis solent impallescere eodem morbo tentantur." Another proof, though a negative one, of its *nervous* origin, is presented in the fact, that, however acute may have been the local pain, dissection casts no light on its pathology, the seat of all the suffering evincing, in a large majority of instances, no discernible cause of its intensity, whilst the whole class of tonic remedies which would aggravate the mimic inflammation, were it otherwise than visionary, is that which experience establishes as the most conducive to relief, the disease being dependent, in fact, on loss of tone, with excess of nervous susceptibility.

It would be a culpable omission, in speaking of the influence of the mind as a cause of disease, were I not to make a brief allusion, also, to that aristocratic visitation termed the Gout. We know that, independently of hereditary disposition, its *seminium* is in the stomach—that its agency is conveyed by the blood to the organs which it principally invades, and that excesses of an Epicurean character will produce and mostly generate a paroxysm. It cannot, however, be denied that all powerful mental emotions, though opposite in their nature, will generate it also in a gouty subject, and that a fit of anger is a notoriously frequent exciting cause. The passions may either occasion an attack or cause its retrocession, or give birth to some irregular or misplaced action and the suddenness of metastasis proves that the inflammatory type is one "*sui generis*," and deviating from the nature of inflammation in its ordinary form. If, as I have before observed, and as must be universally admitted, the influence of the mind will alter the secretions, there is no reason why the stomach and its office of digestion should be exempted. We know that the sudden announcement of bad news will at once take away the appetite;—and why? The shock vibrates to the various parts of the body, through the medium of the nervous and circulating systems; the nervous energy, is thereby partially paralysed; the function of digestion is consequently deranged, and a paroxysm of gout is at once generated, where the predisposition exists.

Weakness of the remote nervous ramifications will necessarily influence the secretions of the parts which they supply; and when, as in gouty subjects, the blood abounds with excrementitious matters, the exhaled and secreted fluids possess preternatural or morbific properties, which affect the sensibility of the extreme nerves, and irritate the tissues in which they are deposited. The electric rapidity with which *Matastasis* occurs can only be explained by reference to the organic nervous system, in co-operation with the arterial; the *materies morbi* being vested in the peculiar state of the blood. Now, if we contemplate the intimate connection which subsists through its medium, we can easily comprehend the transference of sensibility from one part to another. The tone, however, if not the structure of a part having been impaired by previous attacks, renders that part constantly liable to a fresh invasion; or it may visit other organs, according to the several causes which prevail, or the vascular conditions which at the time may happen to be in existence in those organs.

In consequence of frequent and severe attacks the structure of the minute vessels subsequently becomes altered, and the lithic lava of gout is at length deposited in the form of tophi or chalk stones.

Temperament is frequently connected with the progress of disease. There can be no doubt that the irritable temperament—*i. e.*, the sanguine, is more peculiarly under the influence of casual injury and of disease, and that an accident which in others would yield to the *vis medicatrix naturæ*, is frequently followed up in such subjects by serious constitutional disturbance. This temperament, wherein, as Hunter shrewdly observes, there is an ‘ overaction to the strength of the parts," is characterized by extraordinary vivacity of the nervous and vascular systems. Tremblingly alive to the slightest impressions, the sensibility of such persons is more acute; and I am firmly of opinion that they suffer infinitely more pain under surgical operations, as well as more grief under mental affliction, than others who are not thus endowed. The mind is susceptible of greater emotions—their feelings are less under control—they float more buoyantly on the surface of hope, or they sink more deeply beneath the depths of despondency. They are more liable to tetanus after an operation, and their recovery is more uncertain and protracted. Raving madness belongs more particularly (according to the observations of Esquirol and many others) to the sanguine temperament, whilst the melancholic is most prone to Monomania and depression of spirits: nor is death an unfrequent consequence of this excess of their morbid sensibility. The body in such subjects is the slave of its tyrant empress, and life itself succumbs to her dominion. Such persons have been known to expire suddenly during the steps preliminary to a surgical operation. A striking instance of the fatal agency of the mind is recorded of a man who, under the bloodthirsty Robespierre, was condemned to be guillotined: by some accident the knife was arrested in its descent, and on removing the victim for the purpose of adjusting the fatal apparatus, life was found to be extinct: the mind had anticipated the executioner, and performed his office.

Another instance, which I believe is well authenticated, is presented in the case of three criminals on the Continent, who were condemned to die, and were only reprieved for the advancement of science, and given over accordingly to the tender mercies of surgeons, as the subjects of experiment. These professors informed them, that though the sentence of death was immutable, yet under the circumstances they should suffer little or no pain in its execution, which it was decreed should be carried out by the gradual loss of blood. Their eyes being bandaged, a slight puncture was then made in each of their arms, and a small stream of warm water was poured continuously over the arm; thus giving them the entire conviction that their blood was flowing into the pail beneath. After this had been carried on a reasonable time, it was found that two out of the three had ceased to live! The fatal influence at other times, though equally effective, is more distant.

A surgeon in Essex, with whom I was well acquainted, rode several miles on horseback, early in October some years ago, to consult my father. He was about forty-five years of age, and not only appeared to be, but admitted that he was, in good bodily health; yet a conviction had impressed him that he should not survive the ensuing February. It was in vain that my father endeavoured to reason him out of it, and urged him to follow his favourite amusement of fox-hunting through the approaching season. He did so; but "death on the pale horse" overtook him, and realised his unalterable apprehension. A patient who despairs of recovery is certainly in greater danger than he who is convinced of his convalescence; and the vista of disease is dark and dreary in which the taper of hope has been utterly extinguished. The physician, therefore, who by his countenance or by his manner can inspire it, has gained an unquestionable advantage in the work of his vocation. The patient, especially if of a nervous temperament, studies his every turn of countenance—weighs his every word—and the thermometer of his feelings rises or falls accordingly. The mind becomes enlisted in the service, and by its influence on matter dispels the peccant humours that oppress it. It becomes the duty therefore of the physician to infuse consolation and to inspire hope, wherever he can do so without confiscating truth; for

> "Sunt verba et voces quibus hunc lenire adoloem
> Possis, et magnam morbi deponere partem."

And here, though the language of poetry may by some be deemed inconsistent with the graver matter of a medical lecture, I cannot forego the quotation of lines so beautifully illustrative of the *powers* as well as of the "*pleasures* of hope," as—

> "Go, seek the dismal chamber, where disease
> Reclines with wasted form and pallid hue;
> Where through the half-closed shutter sadly creeps
> A feeble ray that scarce a twilight sheds;
> Whilst all around distressing signs appear
> Of fruitless remedies! Mark, then, how sweet
> To lift the eye of *Hope* upon a friend!
> To feel upon the fluttering pulse the grasp
> Of one beloved—it beats with firmer force—
> The languid eye beams momentary joy;
> And sickness, cheated by the smiling scene,
> Awhile forgets her pain-inflicting task!"

It is the despair of relief that too often impels the sufferer to fly into the arms of death in order to

> "Whirl him, happy riddance, from himself."

This arises most frequently from exaggerated nervous irritation, as in the higher grades of hypochondriasis resulting from both physical and moral causes, and acting with awful severity on the brain through the nerves of the digestive apparatus. In aggravated cases of dyspepsia, where the mucous membrane of the stomach and intestinal tube is disordered, the mind becomes impaired: hope is abandoned: reason is overthrown, or rather, in such cases, as Lord Erskine observed—"Reason is not *driven from her seat*, but distraction sits down upon it along with her, and holds her trembling upon it, and frightens her from her propriety." The delusions of fancy, of disordered imagination, and morbid sensibility, flit around their victim, and terrify him. The sympathetic palpitation of the heart is misconstrued into organic disease; the little nervous or hepatic cough is converted by the imagination into pulmonary phthisis; or the occasional giddiness, confusion, pain, heat, or other anomalous sensations in the head, engender an apprehension of apoplexy, paralysis, or derangement. Sometimes the sufferer avoids society from having lost all pleasure in it; or, if some pitying relative or friend should endeavour to engage him in conversation, he is unable to enter upon it, and swerves perpetually from the subject to describe his feelings, and seek their explanation. Consolation is refused; or the abortive effort to lighten his despondency by making light of his complaints is twisted into raillery, and perverted into unkindness. Tortured by hypochondriasis, and frightened by the ghosts of fancied ills, he flies from one physician to another for advice; or, beguiled by the *ignis fatuus* of empirical puffs and base and baseless promises of cure, he becomes the dupe of quackery and the martyr of imposture. Here there is frequently a reciprocated agency of mind and body; the unremitting nightmare of the mind impairs the secretions and digestion, and the irritability of the nerves and mucous membrane (aggravated perhaps by the drastic purgatives with which he has injudiciously been tortured) has added fresh irritation to the material organ of the mind. It is astonishing to observe how constantly the temper is affected by this malady. A friend and connection of mine, a most amiable man in all the domestic relations of life, and a pattern of piety, became so irascible under its influence, that he would sit before the fire and kick the fender, till he nearly destroyed it; swearing violently on the slightest provocation, and (to use his own words) "longing for a sword that he might cut any one to pieces that came in his way."

It is on the same principle that the drunkard is almost invariably irritable and morose; and a similar effect frequently ensues after a full meal, or on eating indigestible articles of food. The irritation of the gastro-intestinal nerves is communicated to the brain; the temper manifests the stimulus; perception is less acute, and the mental faculties are tarnished and oppressed: hence the valuable Roman maxim, "*Impransi disquirite!*" is evidently founded on observation and good sense.

Notwithstanding the entire derangement of both the bodily and mental functions in this disease, Anatomy has thrown no light on its pathology. Villermay maintains that the primary seat is in the stomach, and that the disease consists in a morbid state and an excess of organic sensibility of the nervous system, which is reflected sympathetically on different organs. Broussais refers it to the coats of the stomach, and a chronic inflammation of its mucous membrane. M. Georget, on the other hand, refers all the phenomena to the brain, and supports his theory with most plausible arguments. Certainly, when the cause in different cases is closely studied, it would appear that sometimes the disease is manifested primarily in the brain, and at others in the digestive functions; each theory has its respective merits. "*Et vitulâ, tu dignus, et hic!*" Be this as it may, the stomach in either case is affected. The hypochondriac, however, must not only abstain from those ingesta which augment this irritability, but must also exercise some moral restraint, and do his utmost to curb the first impulse of temper, by the aid of his reason and religion, as well as by abstinence. Many, after their nervous energy is exhausted, resort to fresh stimulus and to narcotics, and with temporary relief; but the irritability is mostly exasperated by such measures after the soothing effects have passed away; and both insanity and suicide have been the ultimate result.

Want of proper restraint during infancy and childhood lays the foundation of irritability of temper in numberless instances, and affords a a lamentable illustration of the mind's dominion. That irritability swells into incontrollable passion, which grows with their growth, and strengthens with their strength, till the mind assumes an unhealthy condition, runs away with the reason, and becomes insensible to its curb. Cerebral excitement at last induces cerebral disease; the membranes become vascular, and subsequently thickened, and the reiterated moral is converted into a permanent physical cause of mental derangement.

Abundant instances might be adduced of sudden death from the vehemence of anger, as well as of its devastating effects on the organismus of our bodily frame. Amongst the former may be enumerated the celebrated John Hunter—dying in St. George's Hospital, from the irritation consequent on opposition to one of his motions at the weekly Board of its Governors! Cheyne, Bonetus, and other authors give similar instances. The secretion of bile is unquestionably deteriorated by the operations of the mind; its blackened inspissation, combined with depression of spirits, has supplied the appropriate cognomen of melancholia. This is corroborated, moreover, by the relief that it derives from mercury, and its specific action on the liver, as well as the relief given to the irritated gastro-intestinal nerves by carrying off the acrid secretion by mild and cooling purgatives: and hence Lord Byron declared that an ounce of salts exhilarated him more than a bottle of champagne! Since, however, both mind and body suffer in hypochondriacs, both demand our attention. Where the disease is traceable to hard study, close confinement, &c.—which so frequently happens—it is evident that both must be discontinued; and where (as in Broussais' theory) there is evidence of "gastro-enterite," the antiphlogistic plan must be adopted in the first instance, and the tone of the stomach subsequently repaired by that regimen and those medicines which experience has established as most efficacious, but which it is superfluous that I should here enumerate.

Thus far I have cursorily alluded to some of the manifestations of mental influence in the form of those ordinary diseases which are daily subjected to our attention; and in so doing I have sought to refer the agency to that animal electricity which (as I have observed) so many physicians and philosophers consider the most plausible explanation. A careful contemplation of the phenomena can, in my opinion, bring us to no other satisfactory conclusion; and the more closely they are analyzed and the more attentively examined, the stronger is the corroboration. But—

> "Est quodam prodire tenus, si non datur ultra."

There is a boundary which we cannot pass, and there are secrets in nature, hidden from our eyes, which can probably never be revealed. The material organ of the mind is within our grasp,—albeit, its subtile essence still eludes it; as the mariner can shift his sails and shape his course through the deep, but cannot control or command the winds that waft him through it! The human mind, even in its highest state of culture, is inadequate to the attainment of many mysteries; but light from Heaven, which has shone on many scenes of former doubt and darkness, may yet conduct the diligent inquirer to truths such as human intellect has never hitherto attained.

We have taken a glance of the power of the mind in producing disease and even death, and we have yet much before us as we advance. It may not, however, be irrelevant to direct our transient attention to its powers, and also to its condition, apart from disease—viz. in a state of Sleep, a state in which the external senses and the voluntary motions are lulled into insensibility and temporary quiescence, whilst the involuntary motions are carried on with steadiness, though perhaps with some relaxation of their activity. Here, in other words, the functions of the brain are comparatively suspended, whilst those of the ganglionic system (though sharing a portion of the insensibility of the brain from mutual connexion) enjoy, with modified change, their own inherent power. When the activity of the brain and nervous system has been exhausted (as occurs every 24 hours under the ordinary circumstances of existence,) or when a greater demand than usual has been made upon them by excess in mental or muscular exertion, or by any other course tending to expend their inherent excitability, this well-known miniature of death ensues ; it is, in fact, a most salutary provision of nature for the restoration of that *vis vitæ* which would otherwise quickly be expended altogether. During sleep the process of nutrition is also carried on more perfectly, and with increased activity ; and this is in some measure proved by the increase of corpulence, and general deposition of adipose substance, in those who indulge unnecessarily in it. This is humorously instanced in the fat boy in "Pickwick !" Every farmer knows that, where sleep is perfectly sound, and the mind as well as the body is in deep repose, *both* rest from their labours and regain their strength, and so imperious is the demand where either mind or body have been *entirely* exhausted, that neither silence nor darkness, nor uneasy posture,—nay, not even (as history can establish) the close approach of the hour of a public execution, can sometimes avert it. The fatigue of the body is, however, more inducive of it than fatigue of mind ; for a close attention to literary labour frequently generates an irritability which prevents it ; whereas in Captain Barclay's celebrated match of walking 1000 miles in 1000 consecutive hours, he was not only fast asleep (especially in the latter part of his task) the *moment* he sat down after completing his mile, but it was with the greatest difficulty that he could be aroused at the proper time for accomplishing another—so powerful a sedative is exhaustion !

After a certain time, however (which is when the mental energies are recruited,) the sleep becomes less deep, the waking fancy begins to work, and those inexplicable monsters of the mind called Dreams arise. They are the interludes between sleeping and waking, where imagination is busy whilst reason is prostrate and sensation is torpid, and where, consequently, the altered balance of nervous power distorts the action of the brain, not unfrequently generating intellectual abortions of hideous and incongruous formation. This is painfully exemplified in what is well known by the name of *Nightmare*, where, under that abolition of voluntary power, a painful desire to exert the voluntary muscles arises ; although as soon as those voluntary muscles regain their power, the phantom vanishes. This is consequent for the most part on cerebral irritation communicated by the gastric nerves during a paroxysm of dyspepsia.

Now it is the aggravated state of cerebral irritation attendant on fever which constitutes Delirium. Delirium is nothing more than a protracted dream during a state of disease ; and as dreams generally consist of the revival of old associations respecting past events, or of new ones consequent on recent occurrences, which the intellectual powers are too much disordered to arrange, a confused mass of ideas is presented, and expressed aloud. Delirium, therefore, is a state of thinking, without the person being able to control the association of ideas, or correct his thoughts by external objects ; sometimes they would appear to be prophetic, and their influence over the mind even fatal ! A case illustrative of the power of dreaming is well authenticated in a lady, the daughter of Sir Charles Lee, who stated that one night, when she was in bed, a little old woman came, undrew her curtains, and said—"I am your mother, and to-morrow, by 12 o'clock, you will be with me !" The young lady arose, wrote a letter to her father, sealed it with black wax, and by 12 o'clock on the following day was dead,—so strong was the impression on her mind. There is an inscription on her tomb in confirmation of this extraordinary effect of the mind on the body, even during sleep. Many deaths have been predicted in dreams and been verified ; numbers in lottery tickets have been whispered in a dream, and been drawn prizes ! and some useful admonitions have been communicated, for which "search the Scriptures."

Yet, although this is the ordinary state which constitutes dreaming, there is another state of sleep named Somnambulism, in which the bodily functions are more under the control of the will than what usually constitutes dreaming, so that the individual *acts* under the influence of his conceptions. Here, while the senses are obscured, and all other objects are unperceived, the somnambulist manifests a faculty of seeing, feeling, and of discovering the object of which he is in pursuit; for he walks, and frequently over dangerous places, in perfect safety, and performs many of the common offices of life, and can occasionally hold conversation. The brain would fain appear to be secreting ideas under the influence of sleep, and telegraphing their fulfilment to the obedient muscles of volition.—Many and ludicrous are the instances recorded by medical authors ; nor has the dramatist let pass the opportunity of amusing the public by the representation of these vagaries of Morpheus—"La Somnambula," to wit. I could relate many ; I will only, however, adduce *one* which came under my observation in a young lady of sanguine temperament and high nervous irritability, and who was under my care. She was a person of highly cultivated mind, and devoted herself very closely to the acquisition of knowledge, which was very probably conducive to the irritation. After having been in bed and asleep for two or three hours, she would gradually rise, put on her dressing-gown, go down stairs, walk about the drawing-room, sometimes balance herself like a rope dancer on the back of the sofa as she walked from one end of it to the other ; then go into the dining-room, open the cellarette, help herself to a glass of wine, afterwards return to her bed-room, plunge her face into a basin of water, and get into bed again. When spoken to, she would mutter an indistinct answer. In the morning she was perfectly unconscious of her midnight ramble and only complained of slight headache, but not enough to interfere with her daily occupations.

It is difficult to explain these extraordinary occurrences satisfactorily or pathologically.

The functions of the brain and medulla spinalis are separate—sleep is undoubtedly an affection of the brain; and, where the brain is *much* oppressed, constituting *Coma*, its functions are entirely suspended—in sleep only partially so. Yet the spinal functions continue in office; and though, in a protracted state of coma, not only they would shortly be suspended, but life itself, they are so little affected during sleep that the voluntary muscles have a liberty of action; and somnambulism is equally a result and a proof of this. When the functions of the brain are *entirely* rested, and sleep, exempt from visionary interludes, is dispelled by Nature being restored, it is then perhaps that the intellect is most clear, the judgment most perfect, the preception most acute, the sensibilities most refined. Thus, "The first moment of waking has been defined—that moment of horror to the unhappy when, amidst returning perceptions, increased in acuteness by the refreshment of repose, a sense of misery suddenly darts its sting into the heart, and renews with tenfold vigour its suspended anguish." This is the time when so many victims of mental emotion rush headlong into eternity; and, could many of those unhappy beings who have been found dead in the morning be restored, I have no doubt that they would substantiate my conviction. They try to sleep again, but they invoke the drowsy god in vain:

> "He, like the world, his ready visit pays,
> Where fortune smiles: the wretched he forsakes;
> Swift on his downy pinion flies from woe,
> And lights on lids unsullied with a tear."

Could they but sleep again—could sleep but be induced by narcotics—their melancholy exit had been averted; but, aroused by Nature from that sweet oblivion in which all their cares and troubles were just now shrouded and at rest, the sad reality of their condition is more acutely felt than when mingling with those who carry on the world, and whilst they were comparatively abstracted from themselves by the passing objects around them. The intensity of feeling predominates over every other consideration in that solitary hour, and, getting an unfortunate ascendancy over their better judgment, precipitates them into the abyss which alone appears to promise them a refuge from all sublunary difficulties and anxieties. "Some people" (observes Dr. Burrows) "the more soundly they sleep, when they awake, have all their hallucinations more vivid, and resume all their violence." That the ganglionic system is distinct from the brain is further demonstrable by experiment; for convulsions of the most violent character occur after decapitation, and can be called into action by galvanism long after the manifestations of life have ceased. Again, the spinal functions may be entirely arrested, as in paraplegia, and yet the operations of the brain remain unaffected. For example, I was requested to see a man in my neighbourhood who had fallen from a tree on his back, and fractured the dorsal vertebræ. Entire anæsthesia of the lower extremities ensued, as well as all possibility of moving them; yet his intellect remained unimpaired till a few hours before his death, which did not occur till six weeks after the accident. Many such cases are recorded. All these effects—the classification of nerves, their distinct offices or functions, together with their pathology—are most lucidly expounded in Dr. Marshall Hall's Lectures on the Nervous System; but, as this subject is independent of the operation of *mind* on matter, it may be somewhat irrelevant to enlarge on it on this occasion. Where *mental* shocks are productive of spasmodic affections (of the which they are a fertile source,) it is through the action of the brain on the excito-motory nerves. A paroxysm of epilepsy induced by mental excitement is strongly illustrative of this; and sudden alarm or a burst of anger is a most frequent cause. "Parmi les causes excitantes de l'epilepsie la frayeur tient tout à coup sur le premier rang. La colère, et un chagrin profond, paraissent (après la frayeur) tenir le premier rang parmi les causes de l'epilepsie." It is produced by depressing as well as by exciting passions. When there is a predisposition to epilepsy, a cause of either kind, be it productive of excessive or of defective action, may interrupt the equable transmission of the sensorial power, and thus occasion a fit: and hence it is desirable to retain every patient, who is subject to epilepsy, in a state equally distant from plethora as from undue emptiness of the cerebral vessels. In epilepsy both the cerebral and spinal systems are equally affected, as is demonstrated by the temporary stupor and insensibility in combination with the violent convulsions of the whole frame. The frequent occurrence of an epileptic fit during sleep evinces that it is referrible to venous congestion in the brain; and the termination of the fit in stupor and headache, in addition to the effusion of serum, and other morbid appearances, consequent on repeated attacks, proves how deeply the brain is implicated in this distressing disease. The intellectual powers also become impaired, and frequently terminate in idiocy or insanity, dependent on serious organic lesions within the cranium. In other cases no abnormal appearance is discernible. "Sed et fessi fuerunt summi in arte viri atque in rebus anatomicis peritissimi" (to use the words of Van Swieten) "quod in cadaveribus hoc morbo defunctorum nihil invenerint sæpè quod culpare poterant." The pathology of this disease is unquestionably involved in much obscurity.

Now, connected with or consequent on epilepsy, it is not uncommon to find apoplexy or palsy.—My learned predecessor in this rostrum, Dr. Marshall Hall, classed them, in fact, under one bracket, and supported the theory with his well known ingenuity and talent. He says:—"The patient affected with paroxysmal apoplexy sometimes becomes epileptic; the epileptic, on the other hand, sometimes experiences attacks which gradually assume the more apoplectic character. The fits of apoplexy usually terminate in an apoplectic stupor, and this sometimes in mania." Sudden emotions (as I stated in the early part of my lecture) have very frequently given rise to apoplexy, owing to the highly increased arterial action, and the venous compression attendant on it, of which numerous instances are given in Aretæus, Portal, Cheyne, and other authors; and, as both these states occur in an epileptic fit, an apoplectic or paralytic seizure may naturally be expected.—Paralysis, according to my repeated observation, is more frequently connected with the depressing passions—such as distress of mind from losses, sorrow, frustrated speculations, and other sources of anxiety and disappointment. The nervous energy which had previously subsisted, and carried the projectors through much mental and bodily fatigue, producing increased determination to the brain, with congestion of the sinuses and veins, is succeeded by *exhaustion* of organic nervous power, giving birth, in persons of a gouty diathesis, to an attack of gout—in others, of mature age (and in whom the circulation through the brain is liable to physical imperfection,) to a rupture of the minute blood-vessels, and consequent effusion into some part of the encephalon. The result of such effusion manifests itself variously, according to the seat or to the extent of the lesion that has occurred. It may have occurred in the base of the brain, or in the spinal column, as well as in the meninges or substance of the brain itself. If the effusion in the brain be slight, absorption may take place, attended with entire recovery; or the effusion may increase, and be followed by extension and aggravation of the paralysis, and ultimately by death. But there *can* be *no* doubt that both apoplexy and paralysis are occurring almost daily from intellectual disturbance, and consequent on a deficiency of the due equilibrium of the nervous and vascular systems. Amongst the multitudinous minor instances adducible, another striking instance of the effect of the mind is displayed in the change of the colour of the hair, which becomes rapidly grey, or falls off, under the influence of anxiety and grief. The late chaplain of Newgate told me that he has been astonished at the rapidity with which dark brown or black hair, in young subjects who have fretted after their commitment, has been bleached. A lady of my acquaintance, who experienced great unkindness from her husband soon after marriage, lost every hair, not only from the scalp, but the eye-brows and eye-lashes came off; and her skull in a few weeks, was as smooth and polished as a billiard ball.

Other instances of the extraordinary operations of the mind present themselves in the metamorphoses of the Fœtus in Utero, as is well known, and are highly authenticated; and, moreover, powerfully illustrative of the subject of my lecture—in the dispersion of warts by what is termed charming them—the suspension of an ague-fit by impressing the patient's mind with the conviction that it will not recur (be the instrument what it may)—the removal of disease by pretending to a miraculous agency—of the toothache, by invoking the presence of the dentist, &c. &c.

I will now take a cursory view, however, of the effects of one or two of the passions. I have just observed that Fear, or rather sudden fright, is a frequent exciting cause of epilepsy. Its immediate operation is to paralyze the body, and is therefore precisely opposite to the influence of Rage or violent anger. The respiratory nerves are instantly affected, causing embarrassment in breathing, and accelerated action of the heart, attended with diminution of its momentum, and retardation of the returning venous blood; thus giving rise to the pallor so notoriously characteristic of the passion. There is a temporary congestion, consequently, in the heart and lungs, and exhaustion of nervous power to such an extent that the limbs totter and shake, and scarcely a muscle but participates in the asthenia; sometimes (as I have already observed) the exhaustion of the vis nervosa at once annihilating existence. It is a fertile source also of insanity, as well as of nervous disease. I was consulted a few weeks since in the case of a young lady who was affected with partial hemiplegia and chorea, from being frightened by a crazy man, who forced himself into the house after dark, but she soon recovered. There is a case of fatuity at this time at High Beach, in one of the asylums which I visit, owing to the patient being frightened at school by a mock trial of him for stealing a knife from one of his school-fellows; they pretended that they were going to hang him: he escaped, and hid himself for some hours in a ditch, where he was found idiotic. Numberless similar instances might be adduced, resulting from fancied apparitions, or other causes of terror and surprise.

Look, again, at the consequences of *Grief* on the animal system. We have mentioned one of these in the beginning of my lecture—viz., Carcinoma: and many more sad consequences might be enumerated. It tends, when inordinate, to determination of blood to the brain: it is a not unfrequent cause of insanity; and would be still more so, did not Nature proffer the relief of tears. The countenance at once betrays it: the *depressor anguli oris* is of itself so characteristic of mental sorrow that the artist can instantly pourtray it, and change the representation of laughter into that of weeping by a mere stroke of his pencil, calling that muscle into play. The common phrase of being "down in the mouth" no doubt takes its origin from the action of this muscle. General languor, moreover, prevails; for the exhaustion of nervous energy which follows fast on the agitation and restlessness of sorrow depresses the whole frame, and leaves it in a state of lassitude and inertia. A general stupefaction of the intellect mostly ensues, all the vivid perceptions which might previously have reigned being absorbed or concentrated in the predominant affliction. The expression of countenance is painfully interesting, and his must be a flinty heart in which a feeling of commiseration and sympathy is not excited on witnessing it. All the harsher emotions of the countenance are lost and melted down; and woman is said to be more radiant through the mist of sorrow—

> "So properly the object of affliction,
> That heav'n is pleased to make distress become her,
> And dresses her most amiably in tears."

That the heart may become structurally affected by the continuance of grief may be asserted with little fear of contradiction; or little faith can be reposed in the writings of Corvisart and others, who have studied its pathology with attention.—What is the simple and constant concomitant act of sighing but the comparative inertness of the heart's action, and the consequent impulse of congested lungs to

> "Cleanse the fraught bosom of that perilous stuff,
> That weighs upon the heart."

Sir Charles Bell has beautifully described all the minutiæ, and explained them admirably, in his "Anatomy of Expression," a work which merits a place in every library of science and interest, malgrè a few little errors of opinion. He carries on his illustration even in the brute creation, and demonstrates by close analogy that though they have not, strictly speaking, *reason* for their guide, they have instinct,—nerves, and feelings, and emotions, and passions, in common with ourselves, and so verifies the poet's humiliating assertion, that

> "Man differs more from man than man from beast."

The opposite excitement—viz., that of intense *Joy*—has also a most powerful effect on the system, and is, perhaps, more to be dreaded in its consequences of the two. This has been abundantly witnessed from the sudden and unexpected supervention of great wealth on nipping poverty; and insanity, and even death, have been a not unfrequent consequence; for the mind is elastic, and gradually rises from the weight of sorrow that depressed it; but when the load of embarrassment and anxiety and distress is suddenly removed, and a superabundant influx of nervous excitement is as suddenly infused, the specific gravity of reason is thrown as it were from the mind's centre, and never able to regain her seat. It is an overcharge of animal electricity, and an explosion follows, the illumination and destruction being simultaneous. Instances of its fatal property are recorded and familiar. Pliny asserts positively that the joy of having won the prize in tragedy put an end to the days of Sophocles, and also of Dionysius of Sicily. He also gives the example of the Roman lady who died for joy to see her son safe returned from the battle of Cannæ. Another instance presents in the old Greek who died on the spot from excess of joy on seeing his three sons crowned with laurel at the Olympic games. The pathology is only explicable on the principle of nervous excitement already specified—in other words a shock of animal electricity; for no *structural* disease could be detected by post-mortem inspection under such circumstances. We can only say that the equilibrium of the nervous and vascular systems has been disturbed to a degree incompatible with the laws of existence, and death is the result!

All other emotions and passions are, in fact, only modifications of the influence of the mind on the material organization already described; and it may be difficult to penetrate more deeply into "*cet abyme des incertitudes*" than has been done by those whose names I have quoted, and by other physiologists whose reputation is immortalized by their researches in this interesting branch of medical philosophy, and is identified with it. It cannot be denied that the functions of the brain and nerves—the reflex action of the latter—the respective peculiarities of the sentient and motor nerves—the distinctions between involuntary muscles and muscles of volition—the ganglionic system—the separate offices of the brain and spinal marrow, and all their individual and combined operations and uses, have been most minutely studied, and most assiduously investigated, and partly ascertained, within the last few years, not only by those on whom the grave has closed, but by several who still live to enjoy the *superbiam quæsitam meritis*. Should the latter have retired from the field of philosophy to enter it no more, the laurel still is green upon their brow; and with this encouragement, let us hope that, though the subject is intricate, and the barrier apparently insurmountable, others may not be deterred from prosecuting the inquiry, remembering that

> "The wise and active conquer difficulties
> By daring to oppose them."

In fact, the subject merits even more attention than it has hitherto received; for, however valuable the pathological observations may ultimately be, the inferences which have been drawn from the experiments which have been instituted are nevertheless so incomplete and perplexed, that farther research, and the "*longioris ævi diligentia*," are requisite to verify them. The nature and exact functions of the ganglia—that prime minister of organic life; the sympathetic nerve, with its various connections and offices; the endowments and relations of the medullary and cineritious constituents of the brain and nerves; the unity of the nervous power; the vital principle itself, and its connection with material organization;—in a word, the *terra incognita*, which at present forms the extreme boundary of human knowledge, is still involved in an obscure mist and mystery which affords ample space for our consideration and study.

If Vivisection be indispensable to the further prosecution of physiological inquiry, and physiology stagnates because humanity shudders and shrinks from the infliction of pain, it is gratifying to feel that her handmaid, Chloroform, is come amongst us as though to obviate the leading objection to experiment, and beckon us to farther scientific investigation. Her supreme power over the entire nervous system may ere long open the portal to information which as yet has been closed against us, whilst her anæsthetic agency must rank high amongst the most valuable of modern medical blessings and discoveries. The extended action of it, and of other powerful anæsthetic and stimulant medicines on the nervous system, is a subject well worthy of especial study. It has burst in upon us lately with a dazzling effulgency, although it must at present be considered in comparative infancy. As we employ it more generally, and become better acquainted with it, many advantages may be anticipated from this class of remedy, especially in mental and nervous affections. We all know or have witnessed the operation of the Nitrous Oxyde on the nervous system; the astonishing influence of Mesmerism; the anæsthetic effect of the inhalation of Æther; the operation of Aconite and other narcotics,—the effects of all of which on the brain and spinal marrow are strongly illustrative of the antithesis of my subject—viz., the action of *matter on mind:* and here, amongst the first and foremost, must be classed the maddening fascination and mental bewilderments consequent on Opium and the preparations of it,—that Nepenthe of both mental and corporeal suffering and inquietude,—" sine quo," as Celsus observes, " medicina quasi manca sit, ac claudicet!" How many a painful paroxysm of agony does it not avert! How many a night of ease and tranquillity does it not procure, which, but for " this sweet oblivious antidote," were spent in suffering and restlessness! Who can forget the poetry and pathos with which its Elysian properties have been depicted by De Quincey in his " Confessions!" Yet who would not shrink from the Circæan cup, or dash it to the earth, rather than be similarly enslaved by its intoxications! Under its powerful influence the nervous system is variously affected in different individuals. Perception is confused; ideality is excited; memory is blunted, or is, perhaps, extraordinarily augmented; visions arise which are confounded with realities; and the mind becomes entangled and intoxicated by it! It begins by exciting, but terminates by stupefying the brain, inducing coma and death: but its action on the mind through its material organization is a striking illustration of the dependence on, and the connection of, the one with the other. The sublimities of genius are, indeed, not unfrequently invoked and elicited by these mental stimulants, which excite the brain, though at the expense of the stomach. Many of the fine pictorial productions of Fuseli are said to have been the children of indigestion and irritated brain,—nay, it is asserted that he ate freely at supper of whatever was calculated to cause dyspepsia and nightmare, for this express purpose.

The effects of all the narcotic poisons on the animal organismus are very analogous; some are more rapid in their effects than others, as Prussic Acid; some are attended by convulsions; some dilate, whilst others contract the pupil of the eye. The principal symptoms are cephalalgia, vertigo, affection of the retina, with paralysis, convulsive stupor, and death; but no morbid lesions are discernible from narcotic poisons, unless we include venous congestion or serous effusion in the encephalon. The general impression is, that they either operate on the brain through the circulating system, or, as others maintain, their operation is on the centre of the nervous system, and its sympathy with those expansions of it on which the morbific impressions are made; and the instantaneous death consequent on a large dose of Prussic Acid favours this theory.

The action of stimulants is to awaken the susceptibility to impressions, to pour fresh oil into the lamp of exhausted nature, to sharpen the intellectual energy, and to dissipate sorrow and anxiety. " Give strong drink unto him that is ready to perish, and wine unto those that be of heavy hearts. Let him drink and forget his poverty, and remember his misery no more," said Solomon.

Profane authors teem with such encomiums. Many a passage might be cited from scores of classic authors in support of the exhilarating and creative influence of Wine. Some of our most celebrated statesmen would not attempt to speak, until they had aroused their powers of eloquence by stimulant potations; and Horace asks—

> " Fecundi calices, quem non fecere disertum?"

Energy is therefore the first impression that is made by Alcohol as well as by Opium. The mental function acts with unwonted power; wit is awakened—and fancy and imagination being aroused, and luxuriating with unfettered vigour, the poet and the orator pour forth their sublimest strains, and give utterance to their grandest conceptions. If, however, the stimulus exceed the due proportion, and reason is floated from her capitol, the ideas become confused and incoherent, the powers of the mind are swamped, vertigo follows, bringing exhaustion in its train, and a φευδο apoplexy finishes the scene. Where a copious potation has been suddenly made, not only the mucous membrane of the stomach is inflamed and injured, as Dr. Roupell has ably depicted to us in his treatise, and illustrated with coloured plates, but the shock sustained by the nerves is communicated to the brain, and a fatal result ensues before time for absorption can take place. From smaller proportions, daily and constantly repeated, we have palsy, dyspepsia, mania, delirium tremens, debility, and every indication of the intellect—the brain, and whole nervous system, being shattered and destroyed—and our gaols are crowded, our madhouses are stocked, and our church-yards filled, by the victims of this pernicious and demoralising vice. Without, however, digressing into a treatise on alcohol and its effects, suffice it to say, that the *vis nervosa* and powers of the mind are salubriously augmented or perniciously impaired by its action on the brain, according to circumstances:—and in alluding to the articles which I have just enumerated, I feel that I have adduced the strongest illustrations with which we are acquainted, of the instrumental agency of *Matter on the Mind.* This it is which renders the study of the operations of stimulants and of narcotics particularly incumbent on those who devote their time and attention to the treatment of insanity: for the condition of insane patients is very various. Wine, which in a state of health induces a temporary delirium, will, on the other hand, mitigate or suspend the low muttering delirium of typhoid fevers, where it arises from depressed vitality. The same observation applies to opium. How frequently this is demonstrated in the calmness and rationality with which patients awake, where Morphia has been given in such proportion as to induce sleep under such circumstances! and though of course insanity is not to be confounded with delirium, yet how valuable is the effect of morphia, and of henbane at times, in every lunatic asylum, as well as in the fever hospital! My friend Dr. Seymour asserts the acetate of morphia to be more efficacious in that melancholy stage in which Suicide is to be apprehended, than any mode of treatment which can be adopted; and I fully coincide in such opinion in many instances. It is equally so in puerperal insanity, and in other forms of mental alienation attended with irritation and debility. How strikingly this is evidenced in the delirium à potu, or "tremens" as it is generally termed. Where, from nervous exhaustion, therefore, the nerve matter, whatever it may be, no longer exercises its function as a medium through which the mind exercises volition or receives impressions, morphia would appear to impart a new mode of consciousness. It suspends the exhaustion which causes the disorder of the sensorium in Typhus, and refreshment follows the repose that is induced by it—in a word, the alternations of mental action correspond with states of bodily excitement and exhaustion; but the cause of any deviation from the normal condition of either mind or body must be ascertained before the appropriate remedy can be prescribed, inasmuch as cerebral excitement in an opposite condition would be aggravated by opium or stimulants.

Inequality in the distribution of blood to the brain invariably affects the intellectual functions, be the cause what it may. This is evident in the simple act of fainting (in which all consciousness, perception, volition, and other properties, are suspended for a time) as much as in congestion of the brain. Fainting is, in fact, a vivid instance of the subjugation of the body to mental emotion, for it is a suspension of the heart's action, consequent on a sudden impression on the mind. This theory is, however, opposed by that eminent physiologist Bichat, who asserts that the brain has no immediate influence upon the heart. His opinion was, that the passions and mental emotions are to be referred primarily to the heart, and not to the cerebral system; and in analyzing the pathology of syncope he contended that the suspension of the heart's action was in all cases the *primary* circumstance; that of respiration, sensation, and voluntary motion, being only *secondary*. Great as may be the presumption to differ from so celebrated a physiologist, it is difficult to concur in this opinion; for where it occurs in persons of delicate susceptibility on the sight of a toad, or a spider, or blood, or any other offensive object of sight, (as so frequently occurs,) it is surely an impression on the brain through the medium of the optic nerve, and communicated *secondarily* to the heart and circulating system. Where syncope is consequent on sudden loss of blood, on the heat of crowded apartments, on the use of the hot bath, on long standing, and other physical derivatives of blood from the brain, this theory is admissible; but that it is *also* produced by the agency of the mind appears undeniable, and the etymology of "leipothymia," or "animi deliquium," is accordingly given to it. Since, however, it cannot be denied that Syncope is by no means an unfrequent consequence of FATIGUE,—and inasmuch as I should deeply regret to find myself a remote or proximate cause of such an occurrence in this room by trespassing at *too great* a length on your attention,—I will here close my lecture.

LECTURE II.

On nervous agency—Insanity—early indications of it—instances of the acuteness of insane people—tendency of women to insanity—its exciting causes—study—religion—poetry—Its usual divisions and varieties—ludicrous instances—anecdote of Hatfield and the late Mr. Baron Garrow.—Medical Jurisprudence.—Monomania.—Pathology.—Lunar influence.—Proportions of male and female patients.—Effects of the passions.—Chances of recovery,

In my preceding lecture I endeavoured to pourtray some of the leading agencies of the mind (through the medium of the brain and nerves) on our bodily structure, and, as far as the impenetrable mysteries of the *modus agendi* will admit, to describe their operations and results. Their extensive variety—their extraordinary manifestations—their morbific and fatal consequences, are daily evinced, and indisputably established; and the more seriously we reflect on them, and the more carefully we contemplate them, the more imperatively are we bound to admit—

> "How complicate—how wonderful is man!
> How passing wonder He that made him such!"

We have shown in a few instances how the whole animal machinery is subject to the two classes of nerves—to those which proceed directly from the brain and spinal marrow, and, in accordance with their origin, are termed cerebro-spinal; and to those which are characterized by ganglia, and termed ganglionic. The former comprise that portion of the nervous system which relates to sensation and volition; the latter consist of those which supply involuntary motion, and which are the source of nutrition, and of the movements of the internal muscles over which we have no control. To these Sir Charles Bell has added the "Respiratory:" their functions are separate; and the distinction is demonstrated by the circumstance that the latter can be carried on independently of the former, as has been proved by the physiological experiments instituted by Le Gallois, Sir Benjamin Brodie, Dr. Wilson Philip, and others. There is, nevertheless, a concatenation of the whole nervous system by various minute filaments, connected also with the sanguiferous system; and as the function of secretion is affected by the action of the nerves on the blood, it is evident that the different secretions vary in proportion to the supply of nervous power: hence it is that diseases are established by the combined influence of the brain and spinal marrow, employed as they are in forming the secreted fluids, and in supporting the other processes on which the due structure of every part depends. Hence also arise the phenomena and treatment of disease in general; the restoration of health being, in other words, the restoration of secretions. Now, although I have said that the functions of the sensorial and of the nervous powers are separate, the sensorial power is capable of impressions on the involuntary muscles through the medium of the sympathetic or ganglionic nerves, as is evinced under the excitement of various mental emotions and passions. Again, the temperature of the animal body is maintained by the evolution of caloric from the blood through the agency of the nerves; for the temperature of any part is reduced by whatever impairs the action of the nerves supplying it; and the whole body is reduced in temperature where the whole nervous system is affected. I merely mention these well-known facts in confirmation of the entire subjection of the body to the mind through its material instruments the brain and nerves, and of the immense and universal influence which they possess and exercise over every portion of the animal economy.

The sensorium, evidently residing in and operating at the source of the nervous power, there receives the various impressions transmitted by the nerves, and there influences those nerves which convey its dictates. Thus all the functions of the nervous and muscular systems, by which we are connected with the world that surrounds us, are constantly subjected to the sensorial power; while the functions on which our life depends (with the exception of respiration,) are only occasionally so, and under circumstances in which the will has no control. The muscles of respiration are only partly involuntarily, for we can accelerate, or retard, and for a few seconds control them altogether, as is instanced in what is commonly called "holding the breath," though the impossibility of existence without the act of respiration very soon compels us to renew it. Were it not that the consequences of the lungs being deprived of atmospheric air predominate over that suspension of sensorial power which occurs in apoplexy, death would be the rapid result of every apoplectic seizure. Yet respiration becomes more laboured, slow, and stertorous, in proportion as the sensibility of the sensorium diminishes, till the last gasp is heaved, and life is extinct.

Enough has, however, been advanced in support of the power of the mind, and of its material agents. The respiration is instantly affected by it; and all the chaos of passion and of mental emotion is most graphically illustrated (as Sir Charles Bell has demonstrated) through the medium of what he terms the respiratory nerves.

Without entering farther, therefore, on the physiology of the nervous system, and retracing the ground which has been so assiduously trodden by those celebrated philosophers who have deeply investigated, and ably elucidated that obscure yet interesting mine of science, I have determined to take now a view of the mind of man in a state of disease. I have already represented it in many of its fitful vagaries, and attempted, however feebly, to recal its protean operations to your memory, where, in the zenith of its healthful power, it has partially affected, or wholly subjugated, its fragile encasement.

Over voluntary and involuntary muscles the mind exercises its omnipotence; and be the organ what it may, or the structure what it will, its influence and agency are despotic and supreme! That influence, however, is not confined to it in a state of health, since, when its leading ornament and peculiar human characteristic, Reason, has been overthrown, its many other attributes retain their seat: and memory, perception, volition, passion, sensation, would seem in many instances to have scarcely suffered from the shock. Now, although we began by admitting that the mind and body are distinct, it was also shown that the one was indispensable to the manifestations of the other; and therefore, if its material organ was impaired, the operations of its immaterial tenant would generally be perverted or annihilated. The modifications of disordered action which ensue from its impairment will be principally regulated by the seat of the disease: and a tolerably accurate diagnosis may often be formed accordingly. The form also of the disease frequently betrays the pathology; for the brain, like other organs, being liable to disease of structure as well as to disorder of function, the researches of anatomy have shed a valuable light on the prognosis as well as on the diagnosis of mental diseases.

Insanity exists frequently without any disorganization of the encephalon, is purely functional, and is then infinitely more amenable to remedies; indeed, where it depends on extensive disease of structure, all hope of recovery must be utterly abandoned. Its invasion is generally gradual. There is a period of what has been appropriately termed "Incubation;" and this is the period in which it is the most under our control.

That the longer the disease has existed the less is the probability of recovery, is, I believe, universally acknowledged by all who have devoted themselves to this branch of our profession; and the statistics of the malady prove it. Andral considered it incurable after the expiration of two years; but unless it be dependent on lesion of structure, experience leads me to dispute his opinion. That such recoveries are comparatively rare I am free to admit; but their chances mainly depend on the care, kindness, and comfort afforded them. Many paupers, who had been inmates of workhouses for years, considered incurable, and neglected in consequence, have been restored after a few months' residence in a county asylum, where they have been more carefully treated and more kindly used.

Since, then, the invasion of insanity is generally gradual, the slightest alteration in the habits or natural disposition (especially where there exists an hereditary tendency) should be carefully observed. Few people are Phrenologists, but all are Physiognomists; and the expression of the countenance, and particularly of the eye, will frequently give the first notice of the incubation. It shrinks from the popular gaze, and catches furtive glances of the visitor; it has a sly, and a fixed and downward look; or it has a vagrant and vacant expression; in some it has a quickness and restlessness; but, be the bias what it may, there is an indescribable character beaming through its glassy surface, which tells the tale to the experienced observer. In the exercise of my office of visiting physician to the asylums in Essex for the last twenty-four years, I have always studied this feature, and have found it most valuable in assisting me to decide on the existence of mental disease, where the aberration has been so slight, or the part of sanity so ably acted, as to almost deceive the magistrates who have accompanied me in my visitations, and induce them in fact to doubt the propriety of the confinement. Dr. Male says, "Insanity may generally be discovered by a wildness in the eyes; very high or very low spirits; extravagant or inconsistent conversation or action. The eyes are sometimes fixed for a long time on one object, and often on vacuity. These first symptoms (he adds) usually pass unnoticed by inexperienced observers; and it is frequently difficult to convince them that the patient is insane, unless his conversation is absolutely incoherent, or his conduct dangerous," (p. 209.)

The appeals of patients for liberty are perpetual, and generally supported by so positive an assurance that they are unjustly detained, that I have frequently had great difficulty in satisfactorily controverting them; and special visitations, independently of those which are appointed by the Act of Parliament, have frequently been required for that purpose. A young lady of singular acuteness and of finished education, who held the situation of governess in a family, and was sent to the asylum of the late Dr. Allen, of High Beech, addressed me once in these words:—"I understand, sir, that you are the visiting physician to this establishment, and that one of your duties is to see that no person is improperly confined here. Now, sir, as I assert that such is my position, gauge my intellect!" and in the examination which devolved on me, and which lasted a considerable time, I was most forcibly reminded of the words of Shakspeare:—

> ———"How pregnant her replies!
> A happiness that madness often hits on,
> Which sanity and reason could not be
> So prosperously delivered of!"

In this instance the wildness of the eye was discernible, and at variance with her well-dissembled firmness and self-possession.

The acuteness of the insane in disguising their malady is astonishing. In a case of madness tried at Chester before Lord Mansfield, the patient was so clever that he evaded questions in court the whole day, and seemed to everybody perfectly sane. Dr. Batty, however, came into court, and, knowing the point of the man's derangement, asked what had become of the princess with whom he had been in the habit of corresponding in cherry-juice? Instantly the man forgot himself, and said it was true that he had been confined in a castle, where, for want of pen and ink, he had written his letters in cherry-juice, and thrown them into the stream below, where the princess had received them in a boat. This man had had sagacity enough, during the whole of the day, to answer correctly all the questions put to him in court, Lord Mansfield being the presiding judge. Even the acuteness of Lord Erskine was insufficient (being unacquainted with his particular hallucination) to detect the insanity of a lunatic who fancied himself to be Christ; and he was indebted for the discovery to the presence of Dr. Sims.

Sleeplessness is another predominant feature in early as well as in matured insanity. The sensorium is too morbidly alive to sanction healthy rest, and the busy imagination is at work by night as well as by day. It is mostly referrible to excess of nervous and vascular action in the brain, like the delirium attendant on fever, and is accompanied by the ordinary indications of preternatural excitement consequent on such excess, and superseding the feeling of exhaustion.

A morbid perversion of the affections and natural feelings, though unattended by any perceptible lesion of intellect, is a very frequent early indication; nay, so constant is this moral alienation, that it is considered by Esquirol to be the proper characteristic of mental derangement. We observe it vividly marked in puerperal cases, and I have witnessed feelings of strong attachment suddenly supplanted by indications of decided aversion to the husband and children. Utero-gestation of itself, independently of any tendency to insanity, is frequently accompanied by extreme susceptibility of impressions, by peevish irritability of temper, by depression of spirits, and other reflections of the womb on the brain and nervous system.

The state of the mother during pregnancy is frequently also communicated to the infant, even where no constitutional liability to insanity exists; and it is in the womb that we are to look for some of the modifications of mental disease. The mother, who would otherwise have had the gratification of witnessing the "mens sana in corpore sano" in her offspring, had the current of life and circumstances run smoothly during that important condition, will, if subjected to fright, or vexation or anxiety, or other causes which disturb her mental serenity, give birth to infants whose brain and nervous systems will be liable to convulsive or spasmodic affections; or, as they advance in life, to imbecility or dementia. This was abundantly proved during the excitement of the French revolution, and is too often exemplified in private life, where the woman has been doomed to suffer unkindness, or unmanly violence, from him to whom she had been taught to look for comfort and support.

In a very considerable majority of cases of insanity in women, much of the disease will, however, be found accompanied by irregularities of the uterine system. This condition arises from, or may be partly attributable to, a state of congestion in which the brain participates, combined with the nervous irritation consequent on an altered state of the system, and is frequently relieved by the abstraction of a few ounces of blood. The practice of venesection during pregnancy (which was more common formerly) would, I have little doubt, tend more than any other measure to prevent both puerperal insanity, convulsions, and other common sequelæ of parturition; but the lancet has lost much of its pristine popularity.

In addition to the expression of the eye and countenance, to sleeplessness and alienation of feeling, there are numberless and various indications of change in the mental condition, such as thoughtfulness, inactivity, neglect of and apparent indifference to former pursuits and pleasures, absence, constipation, vitiated secretion, sudden impulses, restlessness, extravagant schemes, suspicion, sudden bursts of laughter or of tears, &c., &c. Some forms of insanity, indeed, so closely resemble aggravated cases of hysteria, as almost to identify them, especially in that form which is termed *Erotomania*. Here there is generally some irregularity in the uterine function, together with excited imagination, protracted desire, and great susceptibility of the whole nervous system, of all which the maiden "nulli bene nupta marito" is peculiarly the subject. This is another illustration of the effect of the mind on the body.

The brain is at first only sympathetically affected; but the reiteration of hysteric paroxysms will occasionally induce a morbid action of it, with delirium, and ultimately insanity,—more particularly where the exciting cause is referrible to blighted hopes and affections. And when I speak of this as a cause of mental derangement, I will venture, without fear of contradiction, to assert that *any* strong impression on the sensorium, or *any* passion in excess, may give birth to it, especially where there is a constitutional predisposition to the malady. Dr. Prichard (the late commissioner in lunacy) considered the passions and emotions the principal and most frequently productive causes of madness; and, in common with Pinel, Georget, and others, was of opinion that the moral causes predominate considerably over the physical. In the wealthy and well educated classes of society there can be little doubt of it, for obvious reasons; but amongst the poor and uneducated I believe that the balance will be found in favour of the latter; their intellect, rusty by disuse, is less under the influence of excitement: their feelings are more dull; their nerves less sensitive; and, unless roused into action by spirituous stimulants, their general susceptibility is less acute. Hence it is that amongst the savage tribes, where the mind is totally uncultivated, insanity is comparatively rare. Rush pronounces it to be unknown amongst the North American Indians. Intense study, on the other hand, is an occasional source of it; and the too close application and over-strained mental exertion in some of the forcing-houses for puerile intellect called "Seminaries," frequently lay the foundation of nervous disorders, and even of insanity, in those who are delicately constituted, or in whom an hereditary predisposition exists.

Rousseau considered reading to be the scourge of infancy, and would not allow his Emilius to learn a line by heart till he was twelve years old. Madame de Sevigny says also:—"Je suis persuadée que la plupart des maux viennent d'avoir le cul sur selle!" Children of the present age are sometimes too much confined; and if constrained (observes Dr. Darwin) to sit in the same place for hours together, are liable to acquire a habit of playing with their hands, feet, &c., called "tricks," to exhaust an accumulation of the irritability by which they are goaded.

Where the amount of study exceeds the capability of enduring it, especially in young subjects, fearful consequences may be expected. The susceptibility of the immature brain is stimulated at the expense of bodily power; the forced plant is watered with the blood of life, and nature's laws are violated irreparably. Thus, in alluding to the budding genius of "unhappy White," Byron exclaims—

"Oh! what a noble heart was here undone,
When Science self-destroyed her favourite son!
Yes, she too much indulged thy fond pursuit;
She sow'd the seeds, but Death has reap'd the fruit.
'Twas thine own genius gave the final blow,
And help'd to plant the wound that laid thee low!"

Dr. Andrew Combe observes, "I have lately seen several instances of insanity, and also of total incapacity for future useful exertion, brought on by long protracted and severe study, in subjects whose talents, under a better system of cultivation, would have raised them to eminence. Pope was a remarkable example of this. By excessive application he fell into that state of exhaustion which Smollett also once experienced—a "coma vigil"—a sort of torpid indistinct existence—an affection of the brain when the principle of life is so reduced, that all external objects appear as if passing in a dream; and it was only by giving up study and riding on horseback that he regained comparative health. Sir Humphrey Davy brought on a severe fit of illness by over-excitement of the brain in his chemical researches; and in his interesting life of him Dr. Paris has stated that "he was reduced to the extreme of weakness, and his mind participated in the debility of his body," (p. 183.)

It is the same with the brain as it is with the muscles: exercise strengthens and refreshes, but labour weakens and exhausts their power; and, as in the lamentable instance of Sir Walter Scott, where, in the decline of life, his embarrassed mind and circumstances compelled him to force the brain beyond what it was willing to supply, it sunk under the exertion.

Let me not, however, by these observations, be branded with the stigma of discouraging literary labour. A man may denounce intoxication without abjuring wine,—and a physician may prescribe opium with advantage, though an overdose may destroy life. The mind of every man is not only capable of, but improved by a definite proportion of exertion. Attention may be, and ought to be, kept up for a certain time; and, by frequent exercise, the study which at first occasioned fatigue may be protracted with facility and pursued with pleasure; and it is worthy of record, that mathematicians and philosophers have generally attained a considerable age,—so that even abstract calculation, or correct thinking, does not appear, with all these delirious visitations, to shorten the duration of life, or Sir Isaac Newton would have died long before he reached his 85th year. Mathematics have, in fact, been considered to be prophylactic of insanity, instead of inducing it; and Plato designated mathematical demonstrations the "purgatives of the soul." Certainly, as the late Sir Henry Halford observed, "nothing more entirely bars the intrusion of 'thick-coming fancies,' by occupying the whole mind, than mathematical studies; and he instances a physician who, whilst he was practising physic with great reputation in the country, became deranged. After a separation from his family of some months, he was advised to resume the study of Euclid, to which he had occasionally dropped hints of his partiality. He did resume it, and with the happiest effect, and recovered at length so entirely as to be able to recommence business in London, and to continue to practise physic until his death," (Essays, p. 134.)

A certain learned member of the present House of Lords, I am informed, is in the habit of seeking recreation of his mind from abstruse political studies, by solving quadratic equations and stiff problems. Lord Bacon advised that "if a man's wits be wandering, he should study mathematics."

The poet, on the other hand, (whose imagination is ever on the wing, whilst his reasoning powers are comparatively at rest,) is more liable to insanity than the philosopher; and it is a curious fact that, in one asylum which I visit, the great nephew and niece of one celebrated poet, the son of the author of a poem which has immortalized him, and John Clare, (the celebrated Northamptonshire rustic poet,) were all inmates at the same time The "Insanit, et versus facit" was frequently exemplified in Clare, even during my visitations; and I have by me several pretty poetical effusions written by him during his confinement there.

Religion, so called, or perhaps more properly spiritual intoxication, is another and a frequent source of mental aberration; and perhaps there is not an asylum of any celebrity, public or private, in which some unhappy victims of misguided fanaticism are not to be found. A mind that is by nature weak, and that having been overwhelmed with sorrow for the loss of relatives or friends, or other depressing events, and, early and deeply imbued with religious feelings, resorts to meditation and retirement for relief, is very liable to melancholia: still more, a man who has been awakened to a sense of contrition from a life of debauchery, by some serious illness, or by the impassioned appeal of clerical eloquence, and impressed with the idea that he has forfeited all hope of forgiveness by his misconduct, abandons himself to sorrow and despair, may be plunged at once into melancholy madness, or driven to a state of raving and distraction from which he may never be redeemed. I cannot recal to memory a more painful illustration of insanity than has been presented to my contemplation in the restlessness and horror manifested by this kind of patient; nor is there a more frequent cause of suicide.

"In minds broken down by adversity," says Dr. Burrows, "and little acquainted with its genuine precepts, a consequence opposite to that which was sought and expected from religion sometimes ensues. In this case the moral feelings have greater force than the spiritual, and the disappointment is not the default of the principles of the Christian faith. However natural it may be for a devout person to discredit that it is ever a cause of mental distraction, or for him who teaches that religion is the sole duty of life to disbelieve that too much enthusiasm *can* subvert the intellectual system, yet it is clear that, under certain circumstances, insanity *is* occasioned through the agency of religion." Enthusiasm and insanity bear such close affinity, that the shades are often too indistinct to define which is one and which the other. The over-zealous, consequently, should be taught to temper their fervour with discretion, and be reminded that the calendar of crime is stained with the blood which has been shed by its fanatical exuberance. It is not *Religion*, but the distortion of zeal, which is a very different thing.

Itinerant preachers, who, abounding in zeal but deficient in judgment, endeavour to frighten their motley and illiterate auditors by declamation, have frequently shaken reason from her seat, and laid the foundation of this distressing type of the disease. A young woman (for the softer sex are principally the victims) came under my care not long since, solely from listening to one of these spiritual empirics. Even divines of a higher order have exercised and evinced almost incredible influence on their congregation. Thus, during a funeral sermon preached by Bossuet, on the death of Henrietta Ann, the daughter of our Charles I., and wife of the Duke of Orleans, the writers of the time mention that "the whole audience arose from their seats; that terror was visible in every countenance; and that for some moments Bossuet himself was unable to proceed!" The Abbé Caron, who published the life of M.

Bridaine, the missionary, states that, at the conclusion of one of his sermons, at Magnole, on Hell, the auditors were so much affected that they all remained motionless; that for three days following his mission, all the town remained in consternation and mournful silence; and that, in the streets and public places, young and old men were seen lifting their eyes and hands to heaven, and crying aloud "Mercy! O Lord, mercy!" Butler states that he was present at a sermon preached by the late Dr. Hussey, the Catholic Bishop in Waterford; "that during one apostrophe the audience was agonized, and that at the conclusion there was a general shriek, and some fell to the ground," (Reminisc., p. 257.)

With such startling effects on the nervous system as these anecdotes of pulpit eloquence depict, it cannot be a matter of surprise that the brain should sustain a powerful shock, or that its equilibrium should be upset. I have adduced them as additional illustrations of the power of the mind over the body, and deem it unnecessary to enlarge on the *moral* causes of insanity. Amongst the *physical* may be enumerated hereditary predisposition, intoxicating liquors, congestion of the brain from frequent determination of blood to the head, coups de soleil, injuries to the head, narcotics, gastro-intestinal irritation, (of which I spoke in my preceding lecture,) epilepsy, apoplexy and paralysis, metastasis, scrofula and other causes of structural disease in the encephalon, masturbation, venereal excesses, and whatever tends to exhaust organic nervous power.

In mentioning *whatever exhausts organic nervous power*, as one of the physical causes of insanity, I find that I am concurring in opinion with Dr. Henry Monro, who, in a very able treatise recently published, asserts his opinion "that insanity is a disease of deficient nervous tone consequent on loss of vitality." Insanity is a disordered condition of the brain or mental instrument, manifesting itself in a disturbance of the *intellectual* faculties by what are termed hallucinations, or erroneous impressions or delusions [and designated *intellectual* insanity by the late Dr. Prichard]; or, a perversion of all the natural feelings, affections, and habits, without any assignable cause [which the same author calls *moral* insanity]; or, an entire absence of reason, in which the mind is more or less annihilated—in other words *dementia.* The usual divisions are *mania*, *melancholia*, and *idiocy.*

These three deviations from a healthy or normal condition of mind admit of varied divisions and subdivisions, according to the predominant form or character of the disease. The human mind is such a heterogenous mass of ideas and propensities, that when reason has lost her control, they break forth in various forms and degrees, rendering thereby a lunatic asylum a chaos of ungoverned passions, hallucinations, and delusions. Thus, under one roof, we find one man singing, another reciting, another standing apparently absorbed in thought, another melancholy and mute, another walking hurriedly, and muttering incoherently to himself, another full of tricks and mischief,—all and each of them regardless and unconscious of the absurdity of their deportment, and holding no intercourse with their companions, but each playing a part in the waking dream of his own disordered imagination. You are in a group of wakeful somnambulists; some will answer you if spoken to; others will remain obstinately silent; some will give not only a rational but a shrewd reply. Nor do madmen always lose the power of reasoning; on the contrary, they are frequently most acute. but their *Data* are erroneous: they labour under delusions,—and their imaginations convert fancies into realities, and so betray the imperfection of their intellect; for, being regardless of censure or of ridicule, they have no concealment, and therefore reveal their hallucination, and are kings, or deities, or statesmen, or poets, or anything else that may be prompted by their visionary impression; and it is in vain to attempt by force of argument to controvert the impression. This "tyranny of fancy's reign" is most vividly pourtrayed by that transcendant delineator of the human mind, Hogarth, who, in his last painting of the Rake's Progress, has represented the diversity with painful fidelity.

Can we, then, approach any nearer to a definition of insanity, asks Dr. Conolly, (an authority which admits no question and requires no praise,) than by saying that is the "impairment of any one or more of the faculties of the mind, accompanied with, or inducing, a defect in the *comparing* faculty." These self-styled kings, or statesmen, or whatever be their delusion, are unable to compare their assumed condition with the dress, or the society, or the situation in which they exist. Their reasoning faculty may not be wholly lost, but they are blind to the absurdity of their assumption. Their data are erroneous, and what reasoning powers they may possess are exercised on the vision of their imagination. Converse with them on other topics, and they may appear very rational beings; yet in each case there is a diseased state of mind; and this insane belief (arising as it does from a want of power to compare things which *are* with things which *are not*) constitutes their insanity.

Dr. Millingen attended a judge in the West Indies who fancied himself a turtle! This ridiculous impression did not prevent him from sitting on the bench, nor from the fulfilment of his judicial office.

There is no end to the variety or extravagance of delusions in this class of lunatics. A patient now in Mr. Tomkins's asylum at Witham, in Essex, though he answers rationally when you converse with him, is tortured day and night with the impression that he has little devils in his stomach, and that they talk to him and tease him. He was actually crying with vexation when I visited him last week, and asked me if I could not hear them. Even Luther fancied the devil was in him, and that he heard him speak. Dr. Ferriday, of Manchester, Dr. Elliotson informs us, had a patient who imagined that he had swallowed the devil; and so benevolent was he in his feeling, that he would not discharge the contents of his alimentary canal, lest he should let him loose on the world. Bishop Warburton, in a note to one of his works, speaks of a person who thought he was converted into a goose-pie; and Dr. Arnold saw a man who fancied himself in the family way. Even the celebrated Pascal was the subject of a false delusion, and was so entirely impressed with the apprehension of being on the edge of a precipice that was before him, that he insisted on being tied into his chair. This was, as Shakspeare forcibly expresses it in Macbeth—

> ————————" A false creation
> Proceeding from the heat-oppressed brain."

Very many highly interesting instances are detailed in Dr. Conolly's inquiry into the Indications of Insanity, all tending to show how persons may be deranged on *one* or more subjects, while the rest of the faculties are sound; or how they may be deranged on *every* subject,—in which case they display a wild association of ideas and inconsistencies.

Their *Propensities* also break forth in exaggerated disorder, and the depravity of their feelings is often variously manifested, whilst their intellectual faculties are comparatively little affected. They have sudden impulses, and probably destroy their children, or their nearest relations, or their sovereign, and with, perhaps, the best possible intentions. A strong instance of this occurred in the person of Hatfield, and with which I will conclude this catalogue of examples; but it is combined with such an extraordinary instance of memory, that it is deserving of record. The late Mr. Baron Garrow asked me, in the year 1825, to visit Bedlam with him. On entering the hospital accompanied by Mr. Wright, the resident medical attendant at that time, and hearing from him that Hatfield was still there, and that we should see him, Baron Garrow cautioned us not to mention his name, observing at the same time that he was counsel for the prosecution on Hatfield's trial, although from the circumstance of twenty-five years having elapsed, and his never having seen the prisoner either before or since that time, (and then, of course, only in his wig and gown,) it was not to be expected that he should be recognized. Scarcely, however, had we been three minutes in his apartment, when Hatfield, fixing his fierce eye upon the judge, asked him if his name was not Garrow? On being answered in the affirmative, Hatfield said, "Then, sir, I have one favour to ask of you, which is, that as you were instrumental to getting me imprisoned here, you will exert yourself to get me set at liberty!" Garrow then asked him why he had committed this act of high treason on a king who was so highly respected and beloved? To which Hatfield replied, "Because I wished to make a *God* of him!" Many parents have murdered their children from similar infatuations, or to rescue them from a sea of sublunary cares and privations; and the newspapers of the present day have been recently stained with some of these unnatural records.

In very many instances the seat of irritation appears to be in the cerebellum; and all feelings of morality and decorum are prostrated at the shrine of concupiscence. This form of the disease generally leads to a state of fatuity, and terminates in epilepsy, convulsions, and paralysis. In cases of insanity, generally, but perhaps more especially in cases of this character, I have observed a peculiar effluvium to proceed from patients; so much so, that were I to be unconsciously placed where several are congregated, I could at once detect my position. This peculiarity does not appear to be generally noticed by authors, and may probably be occasioned by the influence of the disordered brain on the secretions, unconnected with any want of cleanliness.

To enter into all the divisions and subdivisions of different authors, in their attempts to classify the various forms in which insanity presents itself, would be a work of supererogation in a lecture, and a tedious occupation of attention and of time. Regnault, in his "Competence des Médecins," says—"Les médecins ont voulu classer les Nuances de la Folie, c'est à dire des choses aussi peu susceptibles d'être classées que les Nuages! Quel en a été le resultat? C'est que des mots Grecs ont été substitues à des mots Français, intelligibles pour tout le monde, et des idées contradictoires reunies dans le même mot!" Medical jurists usually class the different forms under the four heads of Mania, Monomania, Dementia, and Idiocy. Nevertheless, medical jurisprudence too frequently enters into subtilties which only serve to perplex a jury, who, from never having given their attention to mental pathology, are of course entirely ignorant of its varieties. These distinctions are occasionally required on a cross-examination by a barrister, with a view to obtaining a verdict for his client, by ingeniously upsetting the evidence which has been elicited by the opposite counsel: he endeavours to entangle the medical witness in the snare of *Definition*—a Charybdis in which the unhappy victim will in all probability be swamped,—"a question which," Dr. Paris observes, "a medical witness is always called upon to answer," it being very difficult to define the invisible line which divides perfect and partial insanity; or he runs him upon the rock of *lucid intervals*.

"To constitute insanity it is not necessary," as Dr. Male says, "to exhibit the ferocity of a wild beast, nor to perform the antics of a buffoon;" *they* speak for themselves. The grand question in a court of law is to decide whether a party be of sufficiently sound mind to manage his property; or (on being tried for murder or other violation of the laws) whether he was conscious of the crime he was committing—whether (in other words) he was in such a state of mind as to render him a responsible agent. The verdict (according to Sir Matthew Hale) "must rest upon circumstances duly to be weighed and considered, both by the judge and jury, lest, on the one side, there be a kind of inhumanity towards the defects of human nature, or, on the other side, too great an indulgence given to great crimes."

That it frequently requires close study, acute perception, great tact, and considerable experience, to arrive at a just discrimination, must be admitted by every one. In addition to which, several interviews may be indispensable before a physician can give a satisfactory opinion; for lunatics are extremely cunning. Many have lucid intervals, (excepting in a state of utter idiocy or imbecility,) and their state of mind varies under different circumstances and positions; so much so that a commissioner would incur a heavy responsibility who should decide a testamentary dispute, or subject a criminal to execution, or even discharge a patient from confinement, without ample previous opportunities of interview and investigation. The physician must adopt his own plans for the attainment of what is required of him, and may bear in mind that which was suggested by Shakspeare in Hamlet:—

> ——————" Bring me to the test,
> And I the matter will *reword*, which *madness*
> Would gambol from"—

a test which Sir Henry Halford states that he found efficient, and which he instances in his Essay on the subject. Professor Taylor also wisely observes, in speaking of wills made by old persons, where, in consequence of alleged imbecility, some disappointed expectant has disputed the will:—" If a medical man be present when the will is made, he may easily satisfy himself of the state of mind of the testator, by requiring him to repeat from memory the way in which he has disposed of the bulk of his property. If a dying person cannot do this without prompting or suggestion, there is reason to believe that he has not a sane and disposing mind," (p. 660.)

In cases of murder, the fashionable plea of insanity or monomania is constantly adopted by the counsel for the defence, and in a great majority of instances with success, partly on the score of humanity, and partly in consequence of the prevalent modern antipathy to punishment by death. It is not, of course, my province to enter on a discussion of the validity of this perpetual plea. Each case must rest on the individual facts which appear on the trial. Justice should not, however, succumb to misplaced lenity, or to legal ingenuity; nor should a mawkish consideration for the murderer rescue him from the atonement which the bible authorizes and the legislature demands.

In alluding to the plea of Monomania, many persons consider it to be a state in which the mind is perfectly sound except on one particular subject; and this construction would appear occasionally to have been substantiated by cases which have been recorded. The barrier, however, between sanity and insanity is not so entire but that some few breaches may be detected. It is, in fact, only a species of moral insanity; but the erroneous impression on one particular point is so strongly marked, as to throw the general character of the mental alienation in the shade. The mind is concentrated on one object or train of ideas, so that the insanity is partial. It manifests itself sometimes in a propensity to theft, sometimes to arson, sometimes to homicide; and the subjection of such a criminal to legal punishment must depend on the general evidence of consciousness of action.

Some persons are only guilty of felony when under the influence of spirituous liquors, and then become dangerous to society. A question naturally presents itself whether such person can be legally detained in an asylum. I have known several instances of this; and a patient is at this time under confinement in one of the asylums of which I am the visiting physician, who attempted to murder his wife, but in whom no evidence of insanity is discernible under the regimen and diet of the institution. A prisoner is now in Chelmsford gaol, and has been there for the last fifteen years, for murder, under the influence of intoxication and passion; and though he was acquitted at his trial, on the ground of insanity, he never evinces it now. If, however, a man, under the influence of ungovernable anger, has either taken, or attempted to take, the life of a fellow-creature; or, if prone to intoxication, and when intoxicated, his self-control and reason are not sufficient to restrain him from homicide, public safety demands his confinement. He subjects himself, when at liberty, to one of the leading physical causes of insanity, and becomes insane, being only sane during the lucid intervals of sobriety. Such subjects, Baron Garrow told me, ought undoubtedly to be under restraint.

To return, however, from this digression on medical jurisprudence, let us take a short view of mental pathology: and here Science receives a check, and Philosophy is staggered—for whilst extensive necroscopic examinations furnish a vast variety of disease in the encephalon of the lunatic, many instances of confirmed and protracted insanity can be adduced, in which no vestige of disease could be detected, and where all the ravings and distorted features of this fell disease have passed away,

> " And, like the baseless fabric of a vision,
> Left not a wreck behind!"

How is this? Has the perturbed tenant left its cell without injuring its material encasement? Has the sword lost its edge, and rusted in its scabbard, without the scabbard participating in the ravage of time and circumstance? What can we say in answer to this query, than that

> " There are more things in heav'n and earth
> Than are dreamt of in our philosophy."

Amongst the principal diseases of the brain in the subjects of insanity, are—evidence of inflammation and its sequelæ in the tunica arachnoidea and pia mater, viz.: thickenings; serous infiltration; and more or less vascularity; injected state of the brain and its convolutions; morbid changes both in its cortical and medullary substance, with increased firmness of consistence of both. In others, a softening of its substance; serum in the lateral ventricles; changes in the nerves proceeding from the brain; the bones of the cranium thickened, and harder than is usual, with inequalities in the cranial cavity; alterations in the structure of the pineal gland and the annular protuberance, &c. Many other appearances have been represented as existing; for, as has been observed by Esquirol, "The inspection of bodies of lunatics offers numerous varieties as to situation, number, and kind of morbid appearances. The lesions of the encephalon are, however, neither in relation to the disorders of the mind, nor to the maladies complicated with it. Some lunatics, whose mental and bodily disease had given suspicion of extensive organic lesion, have presented but slight changes of structure in the brain; whilst others, whose symptoms had been less severe, have been the subjects of great and numerous alterations. But what disconcerts all our theories (he adds) is, that not unfrequently, even in the instance of patients who have passed through all the stages of insanity, and have lived many years under derangement, no organic changes whatever have been traced, either in the brain or its containing membranes."

Dr. Millingen expresses himself of the same opinion, and still farther observes:—"All the organic lesions found in the insane may be also observed in subjects who had been free from mental alienation!"

Dr. Haslam details the morbid appearances on the dissection of 38 cases, in *all* of which there was more or less structural disease. Mr. Lawrence detected the same in 100 consecutive cases that came under his inspection at Bethlem. Mr. Davison, the house-surgeon at the Lancaster Asylum, after a careful examination of more than 200 patients who died in that hospital, says that he scarcely met with a single instance in which traces of diseases in the brain or its membranes were not evident: the pia mater and the cortical substance were the parts most frequently diseased. Dr. Conolly is (I believe) of the same opinion.

It would be easy to recount an extensive catalogue of anatomists and pathologists who have favoured us with the results of their researches, and with their comments and inferences. Martinet appears to have connected the symptoms which have manifested themselves during life with the appearances which have presented after death as clearly and concisely as most authors.

In cases of insanity consequent on physical causes, such as inebriety, blows on the head, &c., it is most probable that they arise from a greater or less degree of inflammation of the brain or its membranes; and so far I entirely agree with Bayle, to whose authority, from his researches and practical knowledge acquired at the asylum at Charenton, much respect is due; and that such cases, when early submitted, yield to the treatment, in accordance with his theory, is a strong proof of its correctness. Dumas, Calmeil, Vogel, and other high authorities, entertained similar opinions. Hatfield was acquitted on the plea of insanity referred to a wound in the head, which he received in action. For this reason, when it can be established, in cases of murder or felony, that the culprit has formerly sustained a wound or injury to the brain, an acquittal on the ground of insanity for the most part follows. The well-known consequences also of inflammation, which so frequently are observed in post-mortem examinations, such as vascularity, thickening, effusion, &c., corroborate the connection of insanity with what he terms Meningitis. But irritation may also produce it in a high degree, and yet leave no visible vestige. We know that excruciating pain attends neuralgia, and yet no organic lesion in the nerve affected is discoverable; and, inasmuch as the nerves are processes of the brain, surely the analogical inference may be admitted.

Functional disorder may exist in any organ without structural lesion; but although anatomy may shed no light, nor reveal its cause, the *existence* of disorder is not to be discredited.

There may be a maniacal *Diathesis* as well as a gouty or scrofulous diathesis; and where the disposition is hereditary, this is most probably the case,—and then a slight cause will be productive of its manifestation.

Failing to demonstrate the union of insanity solely with cerebral disease, many pathologists sought for elucidation in the viscera; and the præcordia, the intestines, the liver, the spleen, the uterus, &c., have in turn sustained the etiological imputation; and some modern authorities refer it to the vascular system. Pinel himself considered the abdominal viscera mainly implicated, whilst others assign it to the ganglia and sympathetic system.

I have already alluded to the action of gastric irritation; and the fact that hypochondriasis, melancholy, and even suicide, result from the depression contingent on hepatic affections, cannot be doubted or denied. The frequency of diseased liver in lunatics has been often noticed in the autopsy of lunatics; this may, however, have been sometimes simply the result of that system of intoxication which has terminated in madness, and so extensively induced it.

In treating on Lunacy, and inasmuch as its etymology would seem to convey that the moon exercises an influence on the disease, and as the question is frequently mooted, it may not be irrelevant to offer a transient notice of it to your attention. It has certainly been generally admitted that the changes in the weather and in our system are connected with those of the moon—an opinion which, whether true or false, might naturally originate with men who were necessarily most attentive observers of everything associated with lunar changes when lunar changes were their sole almanac. In an unlettered age they regulated the movements of the shepherd's life; and whole tribes worshipped this "queen of heaven" with abject veneration, as presiding over every atmospheric phenomenon; and their opinion of her influence over our earth was probable and natural. That the moon has an effect on the tides of the ocean, is undisputed; and surely it is reasonable to suppose, *à priori*, that an influence so powerful as this must also have an influence over atmospheric changes; and to this day (whether or not arising from an indirect operation of the moon) changes of weather more frequently are observed to occur at certain lunar periods than at other times. It is ascertained that the mean barometrical pressure attends the first and last quarters, while its extremes accompany the new and full moon. The electroscope also indicates corresponding changes; and from the observations made by Dr. Allen, of the York asylum, and subsequently of High Beech, amongst hundreds of insane patients for a series of years, he told me that he arrived at the conviction that an excited and unsettled state of mind prevailed more, on an average, at these times than at any other. Lunar phases are by many thought to influence EPILEPTIC lunatics, but not to act upon cases of mania or dementia. Shakespeare says:—

> "Sure 'tis an error of the moon, that comes
> Nearer unto the earth than she is wont,
> And makes men mad!"

We spoke (in the first lecture) of the effects of atmospheric electricity on the nervous system,—and though I willingly concede that the influence of the moon, through the medium of any change in the mechanical pressure of the atmosphere, is so inconsiderable as not to repay us for the trouble of its investigation, yet even this lunar influence is admitted by the best meteorologists of the day. There are few, however, who give much credit to the influence of the moon on insane patients.

The relative proportion of male and female lunatics is a question which naturally presents itself when the subject of insanity is before us; but a difference in opinion prevails in this as well as in most things, and the comparative frequency appears to vary in different countries. In Great Britain the proportion gently inclines to males. In France to females. In Germany to males. In London and Middlesex to females. In the sum total of lunatics in the Asylums of various parts of the civilized world, Esquirol calculated 37,825 males, and 38,701 females: the equality is remarkable,—but when the causes of respective liability are considered, the balance appears to be equal; for although the nervous susceptibilities of women may subject the softer sex to a greater incursion of moral insanity, the proneness to inebriety in man (acknowledged, as it is, to be so frequent a physical cause) would give them the predominance. Alienation of mind is observed, however, at an earlier age in females, and the uterine functions undoubtedly subject them to a large exclusive additional liability; they are also more under the influence of superstition and emotion from different causes; but then their minds are less subject to the ravages of speculation and perplexing pecuniary negociations, intense thought, and its anxieties. The predominance of the malady in men in *England* may be partly attributable to the women being more soundly and religiously educated, to their being more domestic, and less subjected to the excitements of gaiety and mixed society than in France. On this principle it may be explained why celibacy presents a preponderance of lunatics over persons in married life. When persons are married, *Le jeu est fait!* and therefore they are more settled, and exempt from those hopes and fears, those disappointments and anxieties, which are a perpetual source of excitement to the young and single, who have not yet turned over the principal leaf in the book of life. The statistics as to the ages in which insanity prevails, (which is from 20 to 40,) may moreover be admitted in evidence of the prevalence of passion and emotion as inducive of mania.

It may be difficult, however, to say at what age reason usurps her sway over passion, and subjugates her. Suffice it to observe, that few objects are more revolting than "the silver livery of advised age," so polluted with morbid juvenile propensities.

> "Possent ut juvenes visere fervidi
> Multo non sine risu
> Dilapsam in cineres facem."

This is, however, not an unfrequent type of *senile insanity*. As a general rule it may be held that mania in all its forms of excitement appears chiefly in early life, melancholia in middle life, and dementia towards the close: the form of insanity varying much with the respective temperament of the individual, and mostly imbued with the hereditary taint.

Be this as it may, *our passions* may be *considered the chief causes of Insanity*, producing stimulating or depressing effects, which act most generally both on our physical functions and our mental faculties. This circumstance explains the extreme rarity before, and the common prevalence of madness after, puberty, when our relative social condition exposes us to the influence both of our natural passions and their artificial aberrations. When intensity of thought has brought on incoherence, such a confusion prevails in the mental impressions, that no distinct recollection of former circumstances appears to exist. Hence the fact, that subjects who have been insane from disappointment in their fondest attachments rarely mention the name of the object of their love. When they do recollect the person's name, and *appear to be grieved* when it is mentioned, (however violent their outbreakings may be,) we may entertain the most sanguine hopes of recovery. A young man, the only son of his widowed mother, and to whom he was most piously attached, was suddenly restored to sanity on being loudly and abruptly told that his mother was dead! He burst into a flood of tears, was awakened to a sense of his temporary delusion, and reason regained her seat. The sensorium in mania is so susceptible, that violent action may restore sanity or may extinguish vitality; but such sudden terminations are rare occurrences. The duration of it is extremely various. It may remit, or intermit, and these durations of excitement constitute what are termed "lucid intervals." The patient appears to be restored, but the ray of light is often transient and fallacious. It is nevertheless cheering to observe the light of reason breaking in upon the benighted mind, evincing as it does, that though reason may have abdicated her throne for awhile, her restoration is not only probable, but at hand.

After a careful consideration, it appears, as Dr. Burrows observes, that the prognosis may be summed up in the following order.

Recovery may be anticipated in proportion to the youth of the patient, and the recentness and comparative mildness of the attack.

The chances of recovery are greatest in the first attacks, and diminish with each subsequent invasion, and with the duration of the disease and advanced age of the patient.

Mania is cured most frequently—next melancholy and monomania—lastly and the least, dementia and fatuity.

Melancholia is difficult of cure in proportion to the degree of depression—a dread of poverty, of poison, and perverted ideas of religion, indicating an obstinate disease.

Chronic insanity seldom recovers.

Puerperal mania generally.

Insanity with a propensity to suicide is a favourable form, if recent, and coming under early treatment.

Acute dementia is curable—chronic dementia and insanity not so.

Hereditary predisposition protracts and diminishes the chances of recovery, but does not entirely prevent it.

Relapses are, however, more to be expected when it exists.

An amendment of personal appearance attended by improvement in mind, indicates recovery.

When the insane preserve or acquire all their physical functions, and eat and rest well, presenting their usual appearance *without recovering their faculties*, recovery is hopeless.

Insanity caused by excessive study, by the slow operation of moral emotions, or attended by hallucinations, by pride, &c., is seldom cured.

Complications with apoplexy, palsy, and epilepsy, are incurable and fatal.

Men are more liable to relapses than women, and one half of all relapses occur in the first three months after recovery.

LECTURE III.

Statistics of Insanity — Marriage — Necessity of Early Treatment—Mortality—Danger of Depletion—Pathology—Medical Treatment—Dr. Conolly— Dr. Monro—Healthy Condition of the Insane—Advantages of kindness and confidence —Illustration—Suicide—causes of—Hereditary predisposition—Prevention— Idiocy—Speech of Lord Carlisle.—Conclusion.

In taking into consideration the leading characteristics and powerful agency of that gift of God which constitutes the supremacy of man over the rest of animated nature, *The human mind*, I began by attempting to give a sketch (how brief soever and imperfect it might be) of its physiology. I traced a feeble outline of the different leading theories of its mode and power of acting on our corporeal organization; illustrating the abstruse consideration by examples of its effects—its agency in generating diseases—and its connection with various mental passions and emotions. I subsequently took a cursory view of the phenomena of its morbid condition, viz. *Insanity;* and I now, in conclusion, propose to resume the subject of what must undoubtedly be considered the most awful visitation which "flesh is heir to." It is much to be lamented that mental alienation, in one form or another, is and must be perpetually on the increase, for, endowed as it is with an hereditary property more inherent than any other malady, it travels (though "haud passibus æquis") with the increase of population; and I believe that I am not guilty of exaggeration when I state that there are now no less than 80,000 persons in Great Britain and Ireland who are thus afflicted. Dr. Burrows, to whom I have frequently alluded, and whose authority is quoted by all modern writers on the subject, calculated that in six-sevenths of the whole of the patients under his charge the cause was traceable to hereditary disposition. Much of this is attributable to intermarriage, especially in the highest circle of society, where corresponding rank is a principal incentive to that state; and it is distressing to observe how the young of both sexes will rush to the embrace of their wealthy and aristocratic admirers, if a coronet but form the crest, though insanity and scrofula may be the supporters to their arms! Should the families of *both* sides be liable to insanity, the probability of this sad heir-loom is, *à fortiori*, doubled, and the manifestation of the disease will probably be doubled also in the offspring of persons

"————mox daturos
Progeniem vitiosiorem."

Yet, though Insanity is ever on the increase, for reasons just stated, it is equally true and satisfactory to feel that, since it has become the subject of deeper study and closer observation, our knowledge of the treatment and general management of its victims is much enlightened and improved. An erroneous idea once prevailed that it was commonly incurable; and the melancholy subjects of this infirmity were shut up in dungeons and dark cells, and subjected to coercion and cruelties on which it is painful to reflect. "Cribb'd, cabin'd, and confined," no effort was made to restore their intellect, or contribute to their comfort. They passed their gloomy days and wretched nights, year after year, in straw and darkness, till death in mercy came to liberate them from a state of utter hopelessness and unremitting suffering. No commissioners visited them—no friends were permitted to approach them—and the melancholy all that awaited the poor wretches who were consigned to such infamous Bastilles was

"Lasciate ogni speranza, voi ch' entrate!"

Thanks, however, to the enlarged philanthrophy and enlightened aggrandizements of medical science of the present day, this national disgrace is swept away; and the statistics of insanity clearly show that a very large proportion of the insane are now restored to the light of reason, and to the use of all their faculties. Dr. Prichard states that, in *recent* cases, the proportion was 7 out of 8 in the York Retreat. The different forms of the disease are now more deeply studied; their causes ascertained; their differing character met with appropriate medical and moral treatment; and society is enriched by the resuscitation of many a valuable member that had else been for ever lost to it. So amenable, in fact, is it now considered to proper management, that were it possible to obtain an exact comparison of the number of recoveries from other diseases with those of insanity, more would be found to recover from this than from most others. *Early* treatment is, however, so indispensable to rapid recovery, that, were the same prompt attention given to insanity that is generally given to other diseases, still happier results might ensue; but the invasion of mental derangement is often so insidious, and the relatives are so disinclined either to admit its existence, or to reveal it to any one, that the affliction is neglected till its real character becomes unquestionable. But why? as Horace says,

> "——————————Nam *cur*
> Quæ lædunt oculum festinas demere; si quid
> Est *animum*, differs curandi tempus in annum?"

Such, however, is the case;—and the malady, becoming more confirmed by duration, is proportionally more difficult of cure. In estimating the Prognosis, it will be necessary to review the particular species, the predisposing or exciting causes, the simple or the complicated character, the age, sex, and constitution of the patient, as well as the duration of the disease—for the curability mainly, as I say, depends upon these circumstances. I gave a summary of thêm at the close of my last lecture, in accordance with the observation and experience of others as well as with mine own; and the complexion of the malady is now so well understood, that the classification of curable and incurable patients is readily made in every asylum. The cure, however, is not always either permanent or complete. Relapses and recurrences are ever to be apprehended, and each relapse increases the tendency in proportion to the inherent liabilities of the person, or the excitement of the occasional cause. Sometimes recurrences appear to be periodical or intermittent, and I know one case in which the person so afflicted was so aware of the approaching visitation that he always presented himself for admission at a private asylum before each crisis arrived, and requested to be taken care of! The difference between a Relapse and a Recurrence is that, in the former, the symptoms can hardly be said to have entirely disappeared ere they present themselves afresh: in the latter, the restoration to sanity has been complete. The return in both cases generally arises from exposure to what originally induced it, be the cause what it may, and is ushered in by the same symptoms that first indicated its existence. The longer and the more complete the recovery, the less is the liability to a recurrence, and as the frequency of recurrence or relapse arises mostly from premature discharge, patients should be considered exempt from every indication some time before their *Exeat* is signed. Recovery from mania is mostly gradual—a mitigation of the intense symptoms becomes observable, with occasional lucid intervals. Sometimes it is sudden. I gave an instance of it in my last lecture, from the abrupt and sudden intimation of a parent's death: but this is not common. The removal of patients from their own home, and from the circle of their own family, will frequently produce a rapid and strong impression on the malady. The new scene, and the attendance of strangers on patients, awaken the inward inquiry into their situation and position; and the raving state which had hitherto prevailed will lapse at once into a state of tranquillity and silence—"a consummation devoutly to be wished." Where, indeed, the excitement is inordinate, seclusion and confinement become indispensable. By seclusion, I mean simply the removal from noise, or any other excitement, to a quiet apartment, till this turbulent manifestation has subsided; and at the Asylum at Hanwell we find that there are apartments on purpose, the walls of which are all padded, and the floor protected by bedding, so that all possibility of a patient injuring himself is entirely obviated, whilst the irritation of coercion is at the same time avoided. These *derniers ressorts* are, of course, only in extreme cases.

It appears extraordinary that an organ like the Brain, endowed as it is with all the phenomena which regulate existence, and which is so indispensable to life that even the slightest pressure on it simulates death, and annihilates all power both of mental and bodily action, *can* be so utterly disordered as to require incarceration year after year; and that, notwithstanding the privation of its principal functions, life should be protracted in so many instances to so late a period as maniacs attain,—that its intellectual office, in other words, should be totally suspended, and its physical continue unaffected! Yet so it is in some few instances, as the census of the continental asylums, as well as those of this country, can prove. In the comparatively few cases in which longevity occurs, the solution of the problem must be in the strength of the constitution, the absence of any mental anxiety or feeling, and the regularity of life; nor must we omit the care and attention paid to the health of the inmates of an asylum. Dr. Kitchener used to say that "Glass will last as long as iron if you take care of it;" and perhaps nothing conduces more to longevity in ourselves (I speak on the presumption of our *not* being insane!) than regularity in our regimen as well as in our diet. The average mortality I believe to be about 1 in 4, and those who feel an interest in the subject have only to inspect the registry of different asylums and make the calculation: suffice it to say that, in the aggregate (though there are many exceptions,) the mortality of the insane very far exceeds that of an opposite condition, independently of the many fatal complications to which insanity is liable. Of these, by far the most frequent are Apoplexy and Epilepsy, and their concomitants, Paralysis and Convulsion; and these constitute, moreover, the principal fatal terminations. Very many sink from exhaustion, or, as Dr. Henry Monro terms it, "depression of vitality," accompanied sometimes by a general serous effusion and infiltration—the vital energy is exhausted, and the flame goes out because there is no more oil in the lamp. This is especially the case in Melancholia, and also where Mania has degenerated into dementia and idiocy; and inasmuch as insanity is a disease based on debility, such a termination may naturally be apprehended, especially where it has become chronic. In incipient or acute cases there is gradually more or less inflammatory action, with a vascular condition of the brain or its membranes; but then it is of so asthenic a character as not to sanction Depletion in its general acceptation. A few leeches to the head may relieve, and very often do relieve, and the same favourable result is derived from cupping; but the lancet is very seldom admissible, even in raving cases, and is now scarcely ever used. In puerperal cases, or in delirium tremens, we may almost pronounce it fatal, and a discrimination must always be made between inflammation and irritation. The latter state is that which mostly obtains in insanity, and universally in the forms which I have just mentioned. If blood be abstracted, it very rarely exhibits a buffy coat; and what alteration may be observable occasionally, is rather to be explained on the ground of that violent exertion and mental excitement which Hunter affirmed would alter more or less its properties. I attended a case of violent mania not long since, in which blood had been copiously taken by the lancet, and the arm had bled afresh after the surgeon had left the house. I found the patient bathed in profuse perspiration, violent as ever, and restrained by a straight waistcoat;—next day he sank and expired. A post-mortem examination was refused. But in very recent cases (and this was only of three days' duration) it frequently happens that no disease of structure can be detected. In no class of diseases is this more frequently the case than in those of the nervous system. The structure of the brain and nerves is so extremely delicate, and there is something so subtile in their mode of action, that considerable disturbance often arises in their functions without our being able to detect a corresponding physical cause. Many of their disorders are consequently termed *functional*, as we cannot demonstrate to any certainty on what species of diseased structure the various forms of insanity depend. The dura mater, except in cases of violent injury, is comparatively little affected.

In Arachnitis we have generally a complete suspension of the mental faculties, and symptoms which progress from disordered intellect to that of complete destruction of it. There is also coma, accompanied with convulsion, and subsultus. In the *chronic* form, first described by Bayle, the leading character of the attendant delirium is a "heightening and exaggeration of all the ideas." But this state of phrensy gradually subsides into mental alienation, impeded articulation, &c., running on to progressive paralysis both of body and mind. The French pathologists inform us that delirium is more to be expected where the superficial part of the membrane, on the convexity of the brain, is inflamed; but that Coma, Trismus, and Convulsive affections, indicate the Basilary portion to be the seat of disease. The membrane sometimes exhibits *patches* of inflammation; at others the inflammation is more extensively *diffused*, attended with opacity and thickening, and with *adhesion*, consequent on the deposition of albumen or lymph; and it is to the affection of the membranes rather than to that of the brain itself that Bayle, in his "Maladies du Cerveau," attributes insanity, and conceives that the subsequent effusion of serum is (by its pressure on the substance of the brain) the cause of the paralysis and dementia in which it so often terminates. The pia mater is subject to the same indications of disease as the tunica arachnoidea; and with these acknowledged evidences of membranous inflammation it appears strange that copious depletion should not be found advisable, but so it is. Then, again, there is great expenditure of the nervous energy where the brain (from whence all nervous energy proceeds) is thus seriously excited; and this, in my humble opinion, is a main reason why depletion cannot be borne,—why sudden prostration is likely to succeed,—and why death follows fast upon it. Depletion may, and very often does, induce a temporary mitigation of all that tension, throbbing, and other sensations of plethora, which accompany early and acute mania; and those who are comparatively little experienced in such causes are induced to repeat the bleeding, should the vis vitæ and vis nervosa be not knocked down by the first bleeding. In inflammation of the pleura, or peritoneum, or other serous membranes, our mainstay is the lancet, and the loss of blood at times necessary to rescue the patient from the grave is scarcely credible. In the MEDICAL GAZETTE of March 1828, I published a successful case of pleuritis under my care, illustrative of such active treatment, in which one hundred and sixty ounces of blood were taken in five days. Dr. Blundell has also recorded two successful and similar cases, in which a gallon and a half of blood were abstracted in the same short period.

In reports of the Ardent Fever (the Καυσος of Aretæus) of the West Indies, Mr. Comrie, a naval surgeon, says,—"In the course of three or four days above two hundred and fifty ounces have been taken away, and always with success when timely application was made." Here, however, there is no exhaustion of nervous power; the inflammation is confined to a membrane remote from the brain, and unconnected with it; and depletion must be carried till that inflammation is subdued. The physician, must, therefore, use his own judgment in the treatment, taking care not to confound arachnitis, as an idiopathic affection unconnected with mental aberration, with the delirium ferox of insanity, and the supervention of inflammation on it. What I particularly mean to express is, that although post-mortem appearances in Mania frequently give undeniable evidence of inflammation having existed, and although early depletion may be, and is necessary to a certain extent (especially where the subjects are young and plethoric, the invasion of the attack sudden and acute, attended with strong arterial action, heat of scalp, contracted pupil, and intolerance of light and sound, &c.,) the greatest care should be taken not to exhaust nervous energy to such an extent as to endanger the attacks degenerating into irreparable dementia. Pinel was so apprehensive of this result, and so awake to the deceptive character of vascular plethora in the brain, that he opposed bleeding most strenuously, as tending to retard recovery, and even to render recovery doubtful. Esquirol partly coincides in this opinion, but relied more on leeches occasionally; Dr. Rush was particularly blood-thirsty; and Dr. Haslam placed much reliance on it, but not to the extent recommended by Dr. Rush. Dr. Prichard believed the cases to be very few which would yield to large depletion, and considered that the existence of the patient would be much endangered by it. Dr. Burrows (who, following the example and trusting to the experience of others, tried depletion for several years) admits that he discovered his error, and became so cautious in advising it that he scarcely ordered venesection in six cases of mania or melancholia in the same number of years; and that since he changed his practice the cases had been less intractable and less tedious, for he remarked how suddenly the strength of lunatics gave way on general bleeding!

It sums up (as I said before) in this,—that the physician must exercise his own good judgment on this most knotty point in practice (not only in this but in every case, viz. the propriety or impropriety of bleeding,) and prescribe in accordance with it. Suffice it to add, that Dr. Monro, Dr. Conolly, and other eminent physicians of the present day, who have devoted themselves to cases of insanity, deprecate the lancet altogether.

With respect to the substance of the brain, the leading alterations in its structure consist principally of increased firmness of consistence, or of the opposite condition, termed ramollissement or softening; and some pathologists are of opinion that either condition may terminate in its opposite. Both are the result of inflammation. Paralysis is the common result of Ramollissement, and when these are combined it is needless to observe how utterly hopeless the case must be.

Lesion of the cortical substance appears to be mostly connected with the intellectual functions, and disorganization of the medullary to affect more of the motor powers; but disorganization of cerebral substance may exist to a considerable extent without any manifestation of it during life, and large quantities of the brain have come away after severe fractures of the cranium without any deterioration of the intellect. Instances of this are recorded in the Edin. Med. and Surg. Journ., and I have heard also of a boy, who, on a portion of the brain coming away through a fissure in the skull, consequent on violent injury, coolly requested that it might be sent to his schoolmaster, in refutation of the schoolmaster having often told him "that *he had no brains*,"—a point in which they were quite at variance! In a word, great difficulty, uncertainty, and difference of opinion, exist on the physiology and pathology of this important organ, notwithstanding the results of dissection and all the researches that have been made: and more experience is yet necessary, and more study must yet be devoted to it, ere we can decide positively on the contingencies of function and lesion of this empire of reason and the soul! The only method (the late Dr. Baillie told me) of advancing medical science, is to compare the appearances after death with the symptoms that manifested themselves during life, wherever and whenever an opportunity presents. But public Hospitals and Institutions are the only places in which anatomical investigations can be efficiently made.—In private practice it is always unpleasant to make such a proposal, and, when made, the chances are much against its being granted. I can only say, with respect to myself, I have been so discouraged by reiterated refusals that I now very seldom solicit it. Only it is distressing to think how many a valuable specimen of disease which would have been a most desirable acquisition to our Museum, and which might materially assist the advancement of pathology and science, is, through false feeling, consigned to subterraneous decomposition.

Leaving, therefore, any further discussion of the pathological condition of the encephalon, I will merely allude to the visible and outward aspect of the chronic lunatic. Here the hair is generally dry and stubbed, sometimes neglected, long, ragged, and matted; the skin greasy, cadaverous, sallow, with (in many subjects) a papulated variegation resembling acne; sometimes it is dry and harsh, as though there were little or none of that secretion of insensible perspiration which we find in health and youth. There is, in short, a general want of tone in the skin, as well as in the whole constitution; the clear transparency is ill exchanged for a muddy aspect, and the whole appearance of the patient becomes so aged and altered, that, if ever Beauty reigned, scarce a vestige will be discoverable. And yet that fell disease, that fatal scourge of Europe, so linked with Beauty as to carry off more than half her offspring (Phthisis,) is one of the most fatal diseases consequent on insanity. Most lunatics become emaciated; for, ravenous in most instances as is their appetite, the process of nutrition lingers, at least in a large majority, and tubercular cachexia frequently supervenes, or they become atrophied, without the usually prominent features of phthisis. This is, however, by no means universal; for corpulence may be observed here and there in most asylums, and if it were true (which *I* beg leave to deny) that "Fat paunches have lean pates," we might expect a much larger number of them amongst the insane—nay, Bedlem would be crammed with little else! Others die of exhaustion, induced by long-continued excitement, want of sleep, and that smouldering fire of adynamic fever which gradually consumes its fragile tenement.—This latter condition is often leagued with a chronic inflammatory state of the mucous membrane of the stomach and bowels—that subacute "gastro-enterite" on which some authors seem to imagine insanity to be mainly dependent; for, although constipation is a common event in insanity, yet an opposite condition of a dysenteric character will frequently be found to prevail, terminating now and then in colliquative diarrhœa and death. Without, however, concurring in so fanciful a theory as that insanity is a quasi-reflex action from the abdominal viscera, it has been shown by the statistics of upwards of one thousand fatal cases in France, that next to diseases of the brain and its membranes, more deaths were assigned to diseases of the abdominal viscera than to any other cause; and next to them, to diseases of the heart and lungs. The rate of mortality is greater in men than in women. All these numerical results, however, are uncertain, and of course vary with different contingent circumstances in different asylums.

The allusion to these different diseases to which lunatics are liable, and to which they mostly succumb, naturally awakens our attention to the treatment of them. But the medical treatment of these unfortunate beings is principally comprised in the treatment of the several diseases with which they may be visited; for we have no *antimaniacal* drugs—no Pharmacopœia *Lunatica*. Their diseases must be met much in the same way as the same diseases are met and treated where reason is undisturbed; and the hellebore with which Melampus was said to have cured the daughters of Proteus may be classed in efficiency for the *cure* of *mania* with the pills that were sold to prevent earthquakes! Courses of different medicines, such as mercury, emetics, nauseants, cathartics, narcotics, counter-irritants, tonics, &c., have all been tried, and each of them in turn may have been occasionally attended by the best effects, and by recoveries; and (to be brief) where certain symptoms have shown themselves calling for specific medicines, they have (as might be expected) fulfilled the object of their exhibition. Tonics are undoubtedly much required and much used (as may be imagined where debility is so common,) and perhaps *more* than any other class of medicines. Medicines of all kinds are equally necessary, according to circumstances, for the insane as well as for the sane. Nevertheless, there is no *Panacea* in either case! Many cases of insanity present no corporeal disease, though many others are so involved in, or based on it, that they are amenable to cure, in which cases "Sublatâ causâ, tollitur effectus." Hence, a ward in a public lunatic asylum may require as much medicine, and as much variety of treatment, as the patients in an hospital. In fact, they require double care; for the mind is diseased as well as the body, and must be equally ministered to. "No one," as Dr. Davey observes, "can be expected to succeed in the treatment of mental diseases, who fails to regard the brain as the organ of the mind." Again: "As regards the strictly medical treatment of the insane, those general principles of science, physiological and pathological, must invariably direct the practitioner, which he is in the habit of recognizing when engaged in the management of all other diseases, and of every kind of injury; and without great and unremitting attention to the various subjects of diet, ventilation, occupation, amusement, classification, &c., the physician will find all his labour in vain. To these all-important auxiliaries we are indebted more particularly for the successful result of the grand experiment made at Hanwell by Dr. John Conolly, viz., the entire abolition of all kinds of restraint in the management and cure of the lunatic, and the adoption of the humane plan of treatment,—a fact this, than which none other appertaining to medical history is more deserving the gratitude of the philanthropist and the esteem of all lovers of science; and one, moreover, not only well calculated, but destined to give to the name of Conolly a niche in the Temple of Fame by the side of those of Oberlin, Fry, Montague, and Clarkson." I cannot quote this merited compliment to Dr. Conolly, from the work of his former colleague at Hanwell, Dr. Davey, without expressing my unfeigned pleasure in knowing that Lord Ashley (now Earl of Shaftesbury,) whose name and exertions in the cause of Philanthropy stand out in such transcendantly bold relief in the present day, has most successfully set on foot and carried out the means of presenting Dr. Conolly with a substantial testimonial of the high appreciation in which he is held by his medical brethren and others for the science he has displayed, as well as the humanity which he has evinced, in the care and management of the insane.

It is remarkable how healthy the insane are. In a visit which I made last week to the Asylum at Hanwell, in company with Dr. Conolly, I was astonished to find scarcely an invalid amongst nearly one thousand patients,—certainly not half a dozen requiring medical treatment for bodily disease. I have observed the same immunity in the asylums in Essex. Much of this exemption of disease is attributable to the cleanliness, ventilation, regulated temperature, exercise in the open air, regularity of diet and living, and all those known rules and regulations which act as prophylactics generally.

In going round Bethlehem Hospital with Dr. Monro, only yesterday, there was scarcely a patient who had occasion for his professional advice for any bodily disease. There was what sailors call a "clean bill of health" amongst about four hundred of the *detenus*, and the ventilation, cleanliness, and regularity, were striking features of the institution.

The grand principle of modern and improved treatment is to avoid even the appearance of unnecessary restraint, as well as restraint itself; and to treat the insane with a confidence which will almost invariably excite their secret but proudest endeavours to preserve and retain. There is a secret power which holds the helm and guides it more effectually in its controlling and moral influence than the rude restraints applied to the bones and muscles of the human frame. There is no influence so powerful as the sphere of a *moral* influence. Put the padlock on the mind!—the *Lock* on the *Human Understanding!* One of the wildest and most violent patients at this time in the Asylum at High Beech is on his *Parole:* and although he is most anxious to be set at liberty, and continually appeals for it on every occasion of my visiting that asylum, and could at any hour walk into Epping Forest and escape in any direction, no inducement can tempt him to open the latch-gate which bounds the garden in which he daily walks. "*La Liberté nous rend fidèles.*" The reliance placed on his sense of honour has awakened a proper pride within him, and strongly illustrates the good effect of moral treatment. "There is a stage," says Dr. Gooch, "approaching convalescence, in which the bodily disease is loosening its hold over the mental faculties, and in which the latter are capable of being drawn out of the former by judicious appeals to the mind." It is when the icy fetters in which reason has been enchained begin to thaw beneath the genial ray of moral influence, that the prospect and the hope of recovery beam forth. Kindness of manner,—appeals to their sense and sensibility,—cheering promises of cure and liberation,—and dealing with their reason as though she had not been shaken from her seat, soon give the medical superintendent a valuable ascendancy over patients, and materially tend to disperse the thick cloud of delusion in which their intellect had hitherto been enveloped. It obtains their confidence and conciliates their esteem. They look upon their manager as a minister of "balm to their hurt minds," instead of a tyrant and a despot. This feeling was extensively demonstrated during my visit to the different wards with Dr. Conolly last Saturday. Their subservience and affection seemed equal; but

> "If e'er it chanc'd, as sometimes chance it must,
> That one among so many overleap'd
> The limits of control, his gentle eye
> Grew stern,"—

and they were instantly subdued. They are brought to consider themselves as visitors instead of prisoners, and to feel that when their minds, which had been in an unsettled state, shall have recovered their serenity, they will return to their business and their friends. In the interim, their attention is engaged, and their time pleasantly and advantageously passed in occupations connected with trade, or in diversified innocent amusements, both in doors and out, according to their fancy and inclination. It is a signal error to suppose that the insane are to be treated as if they were wholly irrational, for they are not so: very many of them are accessible to reason—at all events, and in all cases, they should be treated as if they were; and (if capable of being reasoned with) a well-directed reply will sometimes remove a false impression from a patient's mind. A lunatic, under the care of the late Dr. Allen, imagined himself to be Jesus Christ, and, in proof of it, showed him a scar he had in his side, which, he said, had been occasioned by his having been pierced with a spear. Dr. Allen, remonstrating with him, remarked that our Saviour was wounded on the opposite side. Ashamed apparently at the fallacy of his own reasoning, he hid himself under the bed-clothes, and never again reverted to the impression.—But, to return to the subject of reposing confidence in patients. Nothing but absolute necessity should justify absolute restraint. It only exasperates the furious, and renders the suicide more determined to effect his purpose. The faults of lunatics, like those of children, should be viewed with pity, for they are the ebullition of feeling without understanding. We must visit them lightly, blending firmness with kindness, and tempering our reproof with moderation and prudence, like the

> "Father!—whose authority in show,
> When most severe, and mustering all its force,
> Was but the graver countenance of love!
> Whose favour, like the clouds of spring, might lower,
> And utter now and then an awful voice,
> Yet had a blessing in its darkest frown,
> Threatening at once, and nourishing the plant!"

As soon as their convalescence renders them capable of estimating kindness, they will much more readily submit, and, even in the height of their most furious paroxysms, it is astonishing how much may often be done by liberality and gentleness. This may be extended or curtailed, according to their conduct; making them sensible of greater indulgence in proportion to their exercise of *Self-control*—a virtue and a duty which should be inculcated and impressed on them in every possible way. I will give one instance, and only one, to show the advantage of liberality combined with the precept of teaching this important duty.

Some years ago, a man, about 34 years of age, of almost Herculean size and figure, and very violent, was brought to the York Retreat. He had been often afflicted; and so constantly, during the present attack, had he been kept chained, and so fearful were those who had the charge of him of his violence and his strength that his clothes were contrived to be taken off and put on by means of strings, without removing his manacles. They were, however, taken off when he entered the Retreat, and he was ushered into the apartment where the superintendents were sitting at supper. He was calm; his attention appeared to be arrested by his new position. He was desired to join in the repast, during which he behaved with tolerable propriety. After it was concluded, the superintendent conducted him to his apartment, and told him the circumstances on which his treatment would depend,—that it was his anxious wish to make every inmate as comfortable as possible, and that he sincerely hoped the patient's conduct would render it unnecessary to subject him to coercion. The maniac was sensible of the kindness of his treatment. He promised to restrain himself, and he so completely succeeded, that, during his stay, no coercive means were ever employed towards him. He was frequently very vociferous, and threatened his attendants, who, in their defence, were very desirous of restraining him by the jacket. The superintendent on these occasions went to his apartment, and though the first sight of him seemed rather to increase the irritation, yet, after sitting some time quietly beside him, the violent excitement subsided, and he would listen with attention to the persuasions and arguments of his friendly visitor. After such conversations, the patient was generally better for some days or a week, and in about four months he was discharged perfectly recovered!

Can it be doubted that, in this case, the disease had been greatly exasperated by the mode of management? or that the subsequent kind of treatment greatly tended to promote his recovery? Surely the case requires no comment.

In descanting on the general nature of insanity, I have hitherto confined myself to those forms which principally come under our notice.

> "*Proxima* deinde tenent mœsti loca, qui sibi mortem
> Insontes peperere manu—lucemque perosi
> Projecere animas!"

And as this is a class of patients whose melancholy exit implants a never-dying horror of the disease, vibrating remotely on surviving relatives and friends, I cannot quit my subject without a few passing remarks on so distressing, but, alas! so common an attendant. Amongst the Greeks, or still more amongst the Romans, Suicide was, under certain circumstances, not held in horror, but in high estimation, and was preferred to slavery or subjection, or the epithet of "nobile" would never have been added to the "lethum Catonis."

In France, it is comparatively little thought of, and though the English are often stigmatized with the propensity, it is far more rife with our Gallic neighbours than with us. The instances and the promoting causes are many and various, and occasionally the deed is done without any apparent incentive. The emotions consequent on a reverse of fortune may perhaps be considered as the principal; nor, when we admit that even the groundless apprehension of it operates as a fearful cause of, and presents a not uncommon feature in the malady before us, can we wonder at the result of the saddening reality. It springs alike from sudden impulse and from long premeditation. It occurs during delirium and mania, and follows on the depression and anxiety respecting futurity in cases of melancholia. Strange as it may seem, such persons who are goaded to madness by the delusive anticipation of pain and hell, rush into its very jaws by the perpetration of a crime which we are taught would subject them to the eternal punishment they dread! It reminds us of the desperation pourtrayed by Byron in a shipwreck:—

> "Then rose from sea to sky the wild farewell,
> Then shriek'd the timid, and stood still the brave,
> And some leap'd overboard with furious yell,
> As eager to *anticipate* their grave!"

Some seek it simply as a termination of *ennui*, of satiety of life and of the exhaustion of all its pleasures; some from remorse and self-reproach, from chagrin and disappointment, from blasted prospects and from blighted hopes,

> "glad to be hurled
> Anywhere—anywhere out of the world,"—

and owing to an impression that the act is almost *inseparable* from insanity, a verdict to that effect is mostly recorded. Could this sudden impetus have been foreseen, or this matured determination been discovered, there is no doubt that it might often have been prevented. A brisk cathartic, or a soothing anodyne, or a calm interposition of consolation or remonstrance, might have at once dispelled the visionary horror which prevailed over their clouded reason; but (as I observed in my preceding lecture) the impulse comes upon them in the stillness of night, when the victim first awakens to a magnified view of his unhappy condition, and when solitude favours the perpetration. The dread of poverty or fear of future damnation is incompatible with life, and drives them on to a madness which no influence of principle can restrain—no regard to consequences can withhold. Occasionally it has resulted from a sort of fascination. Such persons are unable to look down from an eminence or a precipice without an impulse to throw themselves from the top of it; they have been known to request that razors may be taken from their possession, so distressing was the desire to avail themselves of the opportunity or the instrument; and the Monument has now been railed in, to preclude the possibility of such an unaccountable propensity, for it can arise from no process of reasoning. It may be partly physical, affecting the circulation of the brain, which is a reasonable deduction from the accompanying vertigo; or it may arise from a peculiarly high susceptibility, with extreme weakness of the nervous system. Thus we find sudden precipitation occur in nervous fevers and in delirium tremens. Most frequently, some form of partial insanity is the principal or concurring cause.

In many instances of suicide the influence of hereditary predisposition is fully established. Dr. Gall asserted that he observed it in several successive generations, and M. Falret considers it to be more intimately dependent on hereditary predisposition than any other form of insanity, especially in cases of melancholia The seasons are by many supposed to operate, or at least to exercise a partial influence ; and the gloomy month of November has had this imputation cast upon it. The Census, however, leans to the warmer months, and the instances are found to predominate when the thermometer ranges above 70°. A warm and moist atmosphere is found to depress the energies of the nervous system, connected possibly with the condition of electricity in the air, and depressing the spirits ; but these are very insignificant reasons for such an impulse, and we must tax those to which I have already alluded. That the deed is not by any means confined to persons of weak mind is extensively proved, when we reflect on those who have committed it ; on the contrary, it may be easily traced in such cases to vascular plethora in an organ which has been overstrained in its intellectual occupation ; engaged most deeply and responsibly in political and financial measures, in the management of public business or negotiations, by which the equilibrium of the circulation has been disturbed ; inducing nervousness, headache, irritability, and other manifestations almost amounting to delirium. In cases such as this, an appropriate medical treatment, with rest both of body and mind, would most probably prevent such a contingency ; and it is the duty of relations to watch the manifestations of those changes in the feelings and disposition which may often be observable, and which generally precede the act. Common sense will point out the means to be adopted ; and the usual derivatives from the brain, such as local abstraction of blood, cooling saline purgatives, cold water, or evaporating lotions to the head, pediluvia, exercise in the open air, and in some cases (that is to say, where the brain may suffer from *want* of tone) the judicious exhibition of morphia or henbane should be resorted to, in addition to rest from those labours, or removal (where practicable) of those causes to which the phenomena may be referrible or referred.

Where innate and connate idiocy has, from its hopelessness, no further demand on those who are blessed with reason than their mere commiseration, or their Samaritan care, I have nothing to offer beyond the blended breathings of my sympathy with others. In this state, the moral, the intellectual, and the reflecting manifestations are in some nearly, in others entirely, deficient; in some, the instinctive emotions are apparently unfelt or undeveloped—they form the humiliating link of human with animal creation, evincing nothing but brutal propensities and uncontrolled desires—they are rachitic or scrofulous, epileptic or paralytic—and their melancholy state is consequent on unalterable physical disorganization.—Their faces and features are as destitute of expression as though their respiratory nerves were absent or destroyed ; their mouths are gaping and perpetually drivelling, and they to all appearance are dead to all perception, emotion, or ideas. Lord Carlisle has very recently, however, in a public meeting convened for erecting a hospital for idiots, depicted their condition in language so replete with an eloquence which my humble ability would in vain attempt, that, inasmuch as it is too appropriate to require any apology for introducing it, and too illustrative of the subject to sanction its omission, I will proceed to quote it:—

"Yet, upon reflection, few descriptions of persons can be conceived more entitled to our generous sympathy and our active assistance. Without being invested with the more solemn and picturesque drapery of tragic dignity, they are exposed, perhaps, beyond all others, to the cold neglect, the coarse gibes, the brutal merriment of a callous and unfeeling world ; they are the butt and scarecrow of the village green, often the drudge sent out from the domestic hearth. Take it that they meet with no ill treatment—that no aggravation of cruelty or scorn embitters their hard lot—nay, that family decencies and family affections gather round them, guide their path, and smooth their pillow : yet what a life of negatives is theirs at best ! Nature spreads in vain her witchery of hues, her golden sunsets and her starry firmaments ! To their untutored ears music has no melody; to their stagnant minds literature, and science, and art, and the sacred Muse, utter no varied voice ! To their turgid souls devotion points no God ! Too often, though dead to pleasure and to virtue, they exercise powers of mischief and annoyance, and though we must believe and hope they are without the responsibilities of crime, they yet incur all its degradation.

"The instantaneous cure, the entire change of the possessed mind, were only the work of Him whose voice the demons heard, and at once came out." "But," he continues, "there is reason to believe that much may be done—that positive advances may be made—that, by judiciously administering to the requirements both of the physical and moral organization (intimately connected and interlaced as they frequently are with each other), orderly habits, steady employment, rational tastes, kindly feelings, just sensibilities of the affections and the conscience, the sense of right and wrong, the fear and love of God, may be introduced and fostered, and developed into all their multiplied and goodly results ; so that, in fact, in the best instances, the idiot may be converted into a decent and creditable member of society ; in the *worst*, his existence may be surrounded with an atmosphere of comfort and of tenderness."

But enough ! I hope that I have advanced sufficient to give a general outline of my views of insanity, and an abstract of the proper management of its subjects; and more than this is scarcely to be expected in the narrow limits of time assigned to a Lumleian lecture. I have dwelt rather on those divisions of it which are more susceptible of cure, than on the lamentable conditions in which this happy termination is either far less, or hitherto altogether beyond the reach of medicine or management. Would that the third division (by which I mean dementia, fatuity, and idiocy) were equally under our control! Where, however, it has supervened on that disorganization which is incompatible with reason and intellectual function—be it from age, or be it from disease—I fear that little must be expected, and that little can be done. Let us hope, however, that these cheering anticipations may ultimately be realised; that the general diffusion of sentiments so strong, clothed as they are in the drapery of so much eloquence and so much beauty, may be the means of extending the blessing of recovery to those who may at present be considered beyond its pale. Would that I had the capability of enhancing such a blessing either in person or in purse. I can add nothing to language so powerful and so refined. I have not the matter which can contribute more to what little is already known in cases of such a character; neither have I the talent or ability which can justify my trespassing at greater length on your time and your attention. I thank you most cordially for the patience which you have manifested in listening to what I have offered during the lectures which I have had the honour of delivering: and as this is (as I premised) my maiden appearance in the character of a lecturer, I must rely on your kindness to excuse the myriad imperfections in which I grieve to acknowledge they abound.

ON THE

MEDICAL JURISPRUDENCE OF INSANITY.

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On the relation of insanity to certain allied conditions—Resemblance of insanity to dreaming, febrile delirium, and delirium tremens—these occasional causes of the disease—Excited passion and insanity—Psychological character of insanity—Insanity contrasted with allusion, hallucination, delusion, disease with mental symptoms, intellectual dulness, eccentricity, abused fancy, and moral depravity—Pathology of insanity.

Medical and legal doctrines on the subject of diseased mind are even in this present day far from harmonious, and therefore in teaching you what is termed the medical jurisprudence of insanity, I shall consider it right to occupy not a little of the time with a detail of the features of mental derangement, so as to afford you a just notion of what the lunatic condition actually is, and put you in a position to form independent judgments on the points which are referred to medical opinion. In so doing, while I shall seek to avoid all pathological and therapeutic matters as unsuited to the objects of such a course, it may happen, in regard to most of you, that I shall be effecting something in the way of filling up what is ordinarily an unfortunate hiatus in the education of the profession.

Insanity is one of several states of imperfect action to which the organism of the human brain is liable. Among these I may enumerate, for example, the conditions of dreaming, and the several varieties of delirium, all of which are forms of mental unsoundness, having certain common resemblances, and bearing undeniable relations to the state of mind which exists in the insane. They are all conditions in which certain faculties of the mind are in abeyance, and in which, as a necessary consequence, psychical manifestations are perverted or imperfect.

Dr. Holland is of opinion that more cases of insanity bear a similarity to the mental phasis which constitutes dreaming, than to any other cerebral condition whatever; and certainly there are no observations in our power to make, that seem to convey so distinct an impression of the sensorial state of the insane, as those which an individual may attempt, by turning his attention upon what takes place in his own mind when merging into the sleeping or the waking state. In the transition betwixt these two conditions the mental operations have many features in common with delirium and intellectual derangement. As the senses are gradually released from sleep or overcome by it, the succession of thoughts is slowly emancipated from control; the ideas are combined in a manner which is altogether involuntary and dissimilar to the ordinary workings of the imagination. Conceptions take the place of sensations, as in the insane, and sensations become misinterpreted, as happens in cases in which the judgment is diseased. If the train of thought were expressed, it would be in speech as rambling and incoherent as the raving ot the demented. The cerebral condition in dreaming is so far allied to that of insanity, that occasionally a state of painful dreaming gives the first warning of approaching mental disease, and the patient seems to suffer from the disorder in "the howling wilderness of sleep," for some time before it has gained sufficient energy to influence the powers of volition and judgment when he is awake. I have occasionally heard an attack of insanity attributed to a frightful dream, the delusion that afterwards haunted the mind traced to an impression produced in this way, and in some cases have known the state of lunacy to spring apparently directly from that of sleep.

The following seems an example of a cerebral condition induced by sleep merging into that of insanity, the patient going to bed sane, and awaking lunatic:—A female servant in the country, a robust young woman, about twenty-seven years of age, in whom no mental peculiarities had ever been observed, came down stairs from her sleeping apartment one morning complaining of headache, and inability to go about her ordinary occupation. She exhibited much excitement of manner, and confusion in her talk, and repeatedly called out for her master's son who she insisted had been with her during the night, and had promised her marriage, or, as she phrased it, had married her before God. Circumstances were every way at variance with the possibility of her story, and her whole appearance and conversation were manifestly those of a person labouring under an insane delusion. Attempts were made to reason her out of the notion, but in vain. Continuing to become worse, she was sent home to her friends, and put under medical treatment, with so much advantage, that in a few weeks she was allowed to return to service. Her old place, however, very speedily caused the delusion to be renewed in all its force, and she was again returned to her friends, with whom she continued for some months, constantly manifesting the same monomania. She then came under my charge; but it was some months before she recovered, and became aware of the extent to which she had been deceived by her own imagination. A year or two afterwards, when she was in a different part of the country, I am given to understand that the same fancy returned very suddenly when she was in a stooping position cleaning a grate.

The state of dreaming resembles that of delirium or insanity, in a similar disturbance of the laws by which ideas succeed each other in the mind, and a corresponding loss of voluntary control over the trains of thought. Hence the intellectual manifestations of memory and comparison are impaired in both states: conceptions become sensations, constituting dreams to the sleeper, and delusions to the lunatic. If the dreamer added the fancies of his sleep to his waking experience and belief, as an insane person not unfrequently does, and as appears to have happened in the case just narrated, he would in no way differ from the latter.

Betwixt febrile and maniacal *delirium* the distinction seems to be entirely pathological: psychologically they are the same. In the former, the vital functions of the great nervous centre are more deeply implicated, and it is from this character that a diagnosis is best deduced. Either state may pass into the other, the delirium of fever becoming mania, and the delirium of mania assuming an appearance which corresponds to the nervous symptoms in the worst description of typhus. Such changes are effected not by any alteration of the mental, but of the physical symptoms of the disorder. If a fever patient continues to labour under delirium after all other febrile symptoms have abated, he becomes a lunatic patient, and will have to pass from the fever hospital to the asylum. This forms the occasional history of a case of insanity, and most commonly in young persons. The variety of insanity assumed is generally that of dementia, and the recovery, though tedious, is not improbable.

A carpenter's apprentice, aged seventeen, was attacked with the usual indications of fever of a low type. The case throughout was marked by the predominance of symptoms referrible to the nervous system; the skin was very hot; the pulse feeble and quick; the tongue dry and brown; there was much subsultus, and delirium was very persistent. In the course of three weeks all the febrile symptoms had abated; the skin was cool; the pulse at a natural standard, and the appetite restored; but the eyes had a very wild expression; he could not be prevailed upon to answer questions; he was violent and unmanageable, without indicating any reason, or making any complaint. Though his strength was daily improving, and his bodily health apparently restored, the mental symptoms became more and more urgent; and he was considered to be insane, and put under superintendence accordingly. The exact state of his mind could not be ascertained, for he scarcely spoke for several months, but his actions were very extraordinary, and apparently influenced by spectral objects and aural impressions. His recovery occupied a period of fourteen months.

You will find several interesting examples of delusion and mental disease combined with, or resulting from, fever, in Roupell's Treatise on Typhus.

The change from a state of maniacal excitement to one resembling the delirium of typhus, is familiar enough to the superintendents of lunatic hospitals, as of occasional occurrence towards the fatal close of cases of violent and acute mania. In such instances the patient seems to die entirely of the vital exhaustion which is produced by extreme excitement of the nervous system, and an individual, seeing the case for the first time at this stage, might from the symptoms suppose it to be one of malignant fever.

Betwixt the mental condition of *delirium tremens* and insanity, there seems to be no other difference than what is made by duration. If the patient, labouring under symptoms of a certain sort, die or recover within a reasonable time, say two or three weeks, he is said to have had delirium tremens, but if the delirium persist beyond some such period, the case becomes one of mental alienation, and is dealt with accordingly. Such is the history of very many cases of insanity which have had their origin in intemperance.

Besides the above conditions, there are several other states and moods of the mind to which insanity has kindred features; in which there is in degree a similar loss of power over the thoughts, with inefficiency of judgment, and even illusions of sense. Anger, fear, grief, enthusiasm, and excitement of the imagination, may put a fool's cap for a time on the wisest head, producing states that differ from unsoundness only in the shortness of their duration, and the possibility of their being rectified by voluntary effort.

Insanity bears resemblances to various conditions, and presents itself in a variety of forms. Sometimes it is congenital, and consists of undeveloped faculties; the powers of the mind have never been completed, or they have never acquired the energy necessary to manifest themselves in natural activity. Sometimes it mainly assumes the form of ungoverned passion and loss of moral control. Another time it resembles delirium, and consists in intellectual disorder and confusion; and lastly, it may arise from destruction or obliteration of one or more of the faculties of the intellect. In all instances the characteristic is defect of mental power, either congenital or the consequence of debilitating causes. The power which is deficient is the controlling power of the will, as exercised over the current of thought, the relation through which every mental operation is produced. All imperfect mental actions result from this cause, but none of these are denominated insanity unless that imperfect action which has either congenital defect or disease as its cause, and for its sign a relative or an universal incapacity of judging. Observe, I do not say an incapacity of judging correctly, but an incapacity of judging at all: the former would merely indicate imperfect thinking or error, but the latter indicates disease. The loss of the power of judging is exhibited in matters of sense, in matters of conduct, or, it may be, in every matter with which judgment should be concerned. Suppose it to be a diseased perception that cannot be canvassed by the judgment, then the phasis of the insanity is intellectual, and its leading symptom delusion; but should it be an emotion that is diseased, then the moral aspect of the individual is unsound, and the prominent feature a loss of control over actions; and instead of a calm judgment guiding the conduct, you may have an impulse as resistless as a necessity, unassailable by reasoning, and removable only indirectly by treatment.

To constitute insanity, then, it is necessary that a diseased condition of the mind interfere with the production of that result of the comparison of one thought with another which we term judgment. We cannot, in the estimation of Dr. Conolly, approach any nearer to a definition of the state, than by saying, that it is an impairment of one or more of the faculties of the mind, including or inducing a defect in the comparing faculty. Until the morbid action is thus powerful, or thus much extended, it is not insanity. Diseased perception may produce illusion or hallucination, but so long as the power of comparing it with other perceptions is intact and entire, the false impression is corrected, and has no influence, but a voluntary one, upon the conduct. Even should the illusion continue, its inconsistency is more apparent to the judgment, than its existence is clear to the sense. In such a condition an individual possesses a phantasma, but is not possessed by it, it is under the control of his higher faculties: he can compass it about, and deal with it as he pleases. An insane person finds no curative incompatibility with other perceptions in his delusion, because he has no power of instituting the comparison. It controls his will, but his will has no reaction upon it; and he remains possessed by it, and insane, until such time as his volition is enabled so to handle his morbid idea, as to make it subservient to comparison and judgment.

Illusion, hallucination, and delusion, though usual phenomena in insanity, are not sufficient to constitute the disease. These terms are of common occurrence in medical writings on the subject, and are not always used very categorically. An *illusion* is a mistake of the senses, a false perception; a *hallucination* is a baseless creation of the fancy; a *delusion* is an illusion or hallucination misleading the judgment, and governing the conduct. Thus, if a person returning home at night mistook the trunk of a tree for an apparition, that would be an illusion; if he saw a ghost where there was neither tree nor anything else, that would be a hallucination; if he believed in the reality of this conception, he would be under a delusion; and if he continued to act in accordance with such a belief, he would be as one insane, yet not truly mad so long as his obedience to it remained a matter of his own free will.

A careful distinction must be made betwixt *diseases having mental symptoms*, and diseases of the mind; betwixt madness, and such affections as hypochondriasis and hysteria. Hypochondriasis consists of illusions and hallucinations regarding one's bodily sensations, and is therefore not insanity, until these become deep-seated and permanent delusions, compelling to irrational conduct. Hysteria, hypochondriasis, and various other affections, which often precede, cause, and accompany insanity, are not diseases of the mind, but more strictly speaking diseases having mental symptoms, until by generating delusions they pass into insanity, and afterwards continue as complications of the disorder which they have created. Thus we have hysterical mania, which is not hysteria merely, but hysteria and mania combined; so also there is hypochondriacal monomania, which is not hypochondriasis alone, but hypochondriasis and insanity together.

Simple defect of intellectual power, *intellectual dulness*, must not be confounded with the imbecility which constitutes a variety of insanity, which is not merely a feeble intensity of mind, but a positive deficiency of faculties. Wherever there is a feeble exercise of attention, or defective memory, there will be imperfect comparison, and resulting inaccuracy of judgment; but not from these, or similar causes, any necessary tendency to be governed by delusions. In all cases of imbecility included in the term unsoundness of mind, there are both emotional and intellectual deficiency, a loss of control over conduct, and from the antecedence of judgment being in some part defective or diseased, a liability to confound the actual with the unreal. Delusion is not a prominent characteristic, however, for in such cases feebleness is the type of all the mental manifestations, whether healthy or disordered.

Eccentricity has also to be distinguished from insanity. All the insane are eccentric in their ideas, their language, or their conduct, but the merely eccentric have but a voluntary resemblance to the insane. Eccentricities differ from lunacies in not arising from a loss, but from an undue exercise, of the faculty of judgment; very often from a vanity or self-respect in the individual, that leads him to prefer his own judgment to all other judgment, experience, and authority. They offend against custom and experience more than against reason. The eccentric, if he cannot give a satisfactory reason for his outré conduct, can at least assign an intelligible motive: the lunatic has no explanation to afford that does not involve an absurdity. A certain individual behaves in all respects like other men, unless that he constantly walks about without a hat, or any other artificial covering for his head. When questioned upon this point of disagreement with the custom of his neighbours, he says, that nature did not intend the head to have any other protection than what she herself had afforded, that a bare head is more becoming, that he feels himself in every way more comfortable as he is, and that he is certain that he will live longer in consequence of acting in this rational way. In two instances in which lunatics adopted the same habit, the causes assigned by them were of a very different description. One did not have his head covered, because it had grown so large that he could not get a cap to fit it; and the other was so annoyed by certain mischievous tormentors of an invisible kind drumming upon the crown of his hat, that in general he preferred to carry it in his hand. The eccentric man had a rule of conduct, the result of his own narrow judgment; the two lunatics were impelled by fancies upon which their judgment was entirely inoperative. Lord Monboddo, insisting that the human family were originally adorned with tails, showed himself an eccentric theorist; had he asserted that they actually retained them, he would have had an insane delusion, instead of a philosophic crotchet. He would have had a false perception on which his judgment was inoperative, whereas, he was guided *by his judgment* to a strange conclusion.

Eccentricities no more constitute insanity, than idiosyncracies constitute disease; and as these are competent with a sound state of the body, so are those with even a vigorous judgment. For example: there was an old man well known in London in the last century, who was of an ungainly appearance, and subject to occasional attacks of a hereditary melancholy. So inconsistent was he in his habits, that sometimes he practised great abstemiousness, and at other times devoured huge meals, with brutish slovenliness and voracity; sometimes he would persist in drinking nothing stronger than water, but occasionally he drank wine by tumblerfuls. His income was far from large, and not of a certain amount, yet he kept a set of old men and women about his house, whose bickerings and disagreements now and then drove him out of doors. He was in general very loquacious, but had been known to sit in company and drink a dozen cups of tea, without speaking a syllable. When not engaged discoursing, it was his custom to keep muttering to himself. In walking he performed strange gesticulations with his limbs, and would not go in at a door, unless he could effect his entry in a certain preconceived number of steps, and so as to introduce himself on a particular foot, turning back, and recommencing, until he succeeded as he desired. There was a row of posts near his house which he would not pass without touching singly, and if he found that he had omitted one in the series, he retraced his steps to remedy the neglect. He hoarded up orange-skins for some mysterious purpose which he would never divulge. He suffered remorse of conscience for once having taken milk with his coffee on Good Friday. He believed in ghosts, and went ghost-hunting in Cocklane; and he maintained that he had heard his mother calling upon him by name from the other world. Yet Dr. Johnson was so far from insane, that his judgment commanded respect and admiration everywhere, and by the common consent of eminent contemporaries he was the most vigorous thinker and the greatest sage of his time.

There are, however, instances of eccentric conduct resulting from *abuse of the imagination*, which verge closely upon madness, and occasionally pass into it. The distinction is, that the individual's voluntary power over his thoughts is capable of bringing the comparing faculty into efficient operation, when he chooses duly to exert his will. Thomas Hood speaks of one who, in consequence of exciting his fancy by German tales of diablerie, used to fly up-stairs at his utmost speed from the street-door to the attics, because a sort of wager with the devil came into his head, that he would gain the top before counting a certain number, or forfeit eternal happiness. Every one possibly experiences moods which differ in no respect from insanity, than that they are neither permanent nor independent of the will. These may be common in imaginative minds, but instead of being indulged, they should be guarded against and restrained, for, though they exist at first by sufferance of the will, they sometimes gain a strength that defies control, and triumphs over the reason. Hoffmann, a master in fantastic fiction, suffered so much from intemperate abuse of the imaginative faculty, that solitude became terrible to him. He was never quit of a mysterious sense of danger; things the most cheerful became incongruously associated with thoughts the most dreadful, while monsters and spectres, which he himself had created, tyranized over his reason. To appease his terrors, he had frequently to summon his wife from bed, to sit by him as he studied at night. He was constantly on the verge of insanity, and died of spinal disease, his mind being tortured by his fancy to the last hour of his existence.

Often it is not an easy matter to draw a distinction betwixt insanity and *moral depravity*. In every case of mental alienation there is disorder of moral as well as of intellectual manifestations. The moral disturbance is usually the earliest developed feature of the malady, frequently it is the most prominent, and occasionally no other is distinguished; so that the bad have been liable to pass as mad, and the mad for bad, according to the philosophy and fashion of the time. There is no problem in law, medicine, and ethics, of greater social importance, or of more difficult solution, than the discrimination of insanity and vice. A wicked deed may be the result of an undeveloped moral sense, as for example in a child or an idiot; it may be the consequence of such extremity of passion as impels to instinctive, instead of deliberative action; and it may be the indication of a conscience enfeebled by voluntary neglect, and the habitual gratification of evil desires. Any of these states may be simulated by disease; but it is with the two last only that the jurist will have difficulty; for, in all cases of insanity in which the moral sense is non-existent, the powers of the understanding also are either undeveloped or destroyed. No hideousness of depravity can amount to proof of insanity, unsupported by evidence of a judgment incapacitated or a will fettered by disease. In those cases of mental disorder in which the emotions are perverted, and where there is no clear proof of deranged intellect, cases which do from time to time occur, the presumption of insanity, in regard to a criminal action, has to be upheld by evidence of suspension of the will. The actions of an individual in such a state ought to be impulsive, involuntary, and irreconcileable with the idea of a healthy state of the emotional faculties.

I have endeavoured to draw as plainly as possible certain distinctions betwixt insanity and some conditions which, as they are allied to it, are sometimes confounded in it. Let me now request your attention, in conclusion, to a few remarks on its essential nature as a disease. I have already spoken of its psychological character. As a pathological state it is easier to tell what it is not, than what it is. Some will have it to be a disease of the body, in which metaphysics are useless; others, a disease of the mind, to which physic is as inappropriate. Still we find it curable sometimes by moral treatment, sometimes by medical; but far more usually by a judicious combination of the two, and almost never remedied by unassisted nature: a truly impressible condition, and far from an opprobrium medicorum. It is not a purely corporeal disease, like one of the neuroses; it is not a nervous affection merely, but a neurosis and something more; neither is it a purely mental affection, like error or vice. Both mind and body are at fault. According to the views of Feuchtersleben, it is their relation that is diseased; of the body to the mind, so that perception is morbid; of the mind to the body, so that volition is disordered. From which, then, does that disturbed relation proceed, which, when established, becomes reciprocal? If from the organism, it is a physical disease; if from the mind, a mental one, although in a sense not to be defined. Were I to dogmatize to you on this abstruse matter, I would say that there are two kinds of insanity, one a mental disease, the other a bodily one, both acquiring the psychosomatic character. There is a form of insanity produced by mental causes, in which the physical symptoms appear secondarily, which is sometimes curable by moral means, and which, if uncured, either leaves no traces behind, or a morbid anatomy which is its result, and in no case its cause. The other form proceeds from physical derangement, occasions sympathetic mental aberration disappearing with its cause and having a traceable pathology.

Of the allied conditions of which I have been speaking, hallucination, stupidity, eccentricity, excited fancy, and moral obliquity, would range with the former; and illusion, hypochondriasis, and hysteria, with the latter. But the essential state—the diseased reciprocal relation disturbing personality—would be fully represented only by those conditions which I have now omitted to enumerate—namely, delirium and dreaming. The others have a resemblance to insanity in their origin, but do not partake of its essential character.

I repeat, that insanity is not, strictly speaking, to be termed either a bodily or a mental disease; that it is a disturbed reciprocal relation of mind and body; but that in its origin it is sometimes a mental, sometimes a bodily disorder; and that in the allied states alluded to, sympathetic delirium—which, if we recognize the two kinds of insanity spoken of—is a representative of the second, and the delirium of dreaming, which is a representative of the first, are the only conditions that have the same essential nature with what is termed unsoundness of mind.

Medico-legal authority in insanity—Civil consequences of the state—Legal sub-divisions; idiocy, lunacy, unsoundness of mind.—Legal doctrines.—Medical Classification; (a) *general insanity;* 1 *amentia,* 2 *mania,* 3 *dementia;* (b) *partial insanity;* 1 *monomania,* 2 *moral insanity; relation of the foregoing states to each other; doubtful and variable cases—General description of the insane state: the relation of country, age, sex, station, temperament, and social condition, to disease of the mind;* (a) *moral condition of lunatics—Premonitory moral disorder—The emotional features of insanity, selfishness, &c.*

The members of the medical profession have very important duties laid upon them in the detection and discrimination of insanity. They are certainly not more peculiarly qualified than any other equally intelligent class in the community to determine upon the evidence of mental inefficiency, or to come to sound conclusions on the important question of civil competency, and the more difficult subject of criminal responsibility; and, on this ground, their authority in cases of mental unsoundness has sometimes been querulously objected to, and their judgment undervalued. Leaving it to jurymen and judges to solve these questions authoritatively and judicially, there is no class better entitled, by education and general acquirements, to undertake the investigation of mental conditions, and none so well qualified to pronounce upon the point of mental health. It would, however, be to the interest of the public, and the credit of the order, that these particular medico-legal functions were discharged by the specially experienced section of the profession. The medical examiner alone has aids in his knowledge to guide him to a correct opinion as to the healthy or unhealthy state of mental organs, and the soundness or unsoundness of the functions of the brain. He has had practical opportunities of learning how to distinguish maniacal from delirious, lethargic, hysterical, and other allied conditions, and can discover evidence by detecting symptoms which others would overlook, and appreciating indications which the non-professional would misconstrue. The physician is a jurist in cases of insanity, not on psychological, but pathological merits. He knows the phenomena of mental aberrations, and, with no greater metaphysical acumen than his neighbours, is better able to distinguish the results of disease. Insanity is the phenomenon of ignorance or vice as the effect of disease.

Insanity, when substantiated, annuls agreements entered into in that condition, deeds executed, and testimony given; and it is the duty of the medical jurist to examine persons suspected to be labouring under diseased mind, and to give evidence fitted to guide juries to a right decision on the question of the competency or responsibility of such individuals. He has to investigate the foundation for the pleading of insanity, when urged in criminal cases as a reason against trial, judgment, or punishment; and to testify as to the mental condition of parties whose wills, contracts, marriages, declarations, or confessions, are attempted to be set aside upon the same plea. It is upon the written certificates of medical practitioners that a legal warrant is obtained for the confinement of a person as lunatic in any hospital or asylum, by which his personal liberty is infringed, and, it may be, his civil privileges curtailed, and his responsibility to the law for a time suspended. After an individual has been so far recognized as insane, it is necessary, before curators or others can intromit with, or administer his estate, that his incapacity be shown to the satisfaction of a jury, as in a court of commission in lunacy, which is the mode in England, or in the Sheriff's court, which is the plan followed in Scotland. Medical testimony is a necessary preliminary to such proceedings, and in their course the professional evidence is the most important.

Before we turn our attention to the forms and varieties of mental derangement recognized by medical writers who have studied the subject, let me first introduce you to the divisions and doctrines which the authority of the law has established.

Lawyers speak of three forms of insanity—idiocy, lunacy, and unsoundness of mind—and attach to these terms the following meanings: *idiocy* is congenital insanity, and therefore always defect of mind; but the deficiency of intellect must amount to an extreme of imbecility; *lunacy* is an acquired insanity, not of necessity permanent but capable of lucid intermission, or complete cure; and *unsoundness of mind* implies such a degree of mental disease, or decay, as renders the subject of it unfit for the management of his affairs.

All who are idiotic, lunatic, or unsound of mind, are looked upon as incompetent in civil cases; but only the first of these classes are of necessity irresponsible for criminal actions. Lunatics, and others of diseased mind, are accountable for any crime not committed during such a paroxysm of their disorder as may be held to have subverted the power of distinguishing right from wrong.

It will appear to you, then, that we have, in law, three classes of the insane, and, as it were, two degrees of insanity—the lower degree vitiating civil acts; the higher absolving also from criminal liability. Now, the species of evidence admissible for the establishment of the former, or lower degree, will not suffice to substantiate the latter. In respect to a civil contract, proof of incompetency may be derived from any circumstances indicative of diseased mind, even from the character of the act itself; but in regard to a criminal offence, the evidence of irresponsibility cannot be derived from the action, but must be deduced from such other circumstances as manifest the individual's incapacity to distinguish lawful from unlawful.

A civil act, flowing from an insane delusion, will, on that very score, be invalidated, and deprived of efficacy; indeed the rule is, that the civil deeds of a lunatic are void, even when they are not the results of insanity, though to this principle there are recorded exceptions. But a lunatic who has compassed a criminal action is not of necessity absolved from legal consequences, even should the offence have been a natural result of his insane delusion.

Such is a brief statement of legal doctrines; and they have given rise to much and intemperate criticism. They are the results of an imperfect knowledge of the disease, with a clear estimate of its practical consequences. The divisions are not nosological, but judicial; you have not mania, melancholia, and so forth, but only incapacity to learn the law—incapacity for civil freedom—incapacity to obey the law—and incapacity for personal freedom—the exponents of a diseased state conventionally divided into idiocy and lunacy, and, in order that the classification may be perfectly comprehensive, supplemented by a vague condition called unsoundness of mind. A greater anxiety seems manifested to guard the lunatics' pocket, and the interest of his heirs, than to protect his life. He shall not by his harmless folly place either himself or his friends at disadvantage, but a criminal action shall not interfere with his privilege of being condemned. Harmless acts may be evidence of his lunacy, but illegal ones shall not; for it is assumed that he may be blind to what is merely foolish, and yet at the same time able to distinguish and avoid what is sinful. The law has a ready eye for insanity in a civil deed, but will not even look for it in one that is criminal. Freedom of will is held to be quite compatible with diseased judgment; and the mind which is enslaved by a delusion is still presumed to have the power of disobeying it. The plea of civil incompetency can be based upon any action of the diseased mind; but that of criminal incompetency must be laid on a more restricted foundation. Disqualifications for the rational management of affairs where it exists, is in general readily seen in the confusion which it has created, and is always possible of legal proof; but non-responsibility for crime is frequently first suspected, in consequence of the act for which the individual is called in question, and is held to require a species of evidence that cannot be put to a satisfactory test. Under legal expositions of such doctrines, lunatics may be carried from the asylum to the jail, and, almost idiots, swing on the gallows. Not only may such things be, but such things have been, and within recent memory. No degree of imbecility, unless a supreme degree, will annul guilt and avert punishment; for if there be any glimmering of reason, the imbecile is not an idiot in the legal acceptation, but capable of distinguishing good from evil, and thereby accountable to the law. The best evidence of insanity may be rejected in conformity with the above dicta, for doubtless in some instances, the fullest proof of an insane mind at the time will lie in that inadmissible particular, the character of the crime itself. To adduce such testimony would be deemed equivalent to taking for granted that which it is an object of the trial to determine; but, if it is also an aim of the inquiry to come to a just decision, there are cases in which the aspect of the criminal circumstance must be permitted to have influence.

In medical opinion, insanity results from the action of certain pathogenical agents, so limiting the faculties of the mind as to render, in some matters, the influence of judgment unseen, and right conduct impracticable by independent personal effort. Incompetency in the affairs of life is one manifestation of the condition, loss of voluntary control another; but perhaps neither feature is a complete portrait of any one case. It is the accident of external circumstance that educes either characteristic the more prominently, and leads to the mistake of accepting a merely comparative soundness of the other for perfect integrity. For full government of the conduct, all the faculties of the mind are required; and when it is clear that the judgment has suffered to the extent of producing civil incompetency, we must admit that one important guide of the will is enfeebled, and a presumption of irresponsibility already obtained. We, who have daily opportunities for knowing that no vital organ of the animal body suffers alone, may be prepared to give more than due weight to seeming indications of a corresponding analogy in the psychical economy; but when we consider how judgment hangs on memory, memory on attention, and attention on power of will, we cannot but in the very fact of received delusion recognize a defect of the faculty which gives personality to our actions.

The members of the legal profession whom official position has afforded opportunities of becoming acquainted with the nature of insanity, will in general be found to have formed views on the subject more in accordance with medical opinion than those which are ordinarily expressed by their brethren. Were those lawyers to whose duty it may fall to address juries in such cases, to devote a share of their attention to the study of mental disease, either by reading, attending lectures, or, best of all, by visiting the insane themselves, there would be less opportunity to remark a difference between medical and legal opinions.

The most generally recognized division of insanity is into general and partial.

General insanity is unsoundness of the whole mind,—the powers of intellect, emotion, and will, being all involved in a greater or less degree; so that the individual may neither think, feel, nor act, as an intelligent and responsible being in regard to any matters. Such a state may be the result of three different conditions of the mind, and its phenomena will vary with its origin. It may be the natural consequence of the *non-development* of mental faculties to the healthy human standard, in which case thought will be feeble, the expression of emotion imperfect, and conduct foolish. It may result, in a mind of natural capacity, from *disorder* of the mental faculties, occasioned by a loss of voluntary control over the succession of thoughts; and then, thinking will be delirium; language, incoherence; and action, extravagance. Lastly, general insanity may be the accidental consequence of *obliteration* of certain faculties by disease, in which case the phenomena will be a mixture of those of non-development and disorder. There are, accordingly, three distinct forms of general insanity; and to these the terms amentia, mania, and dementia, have been applied.

Amentia is congenital general defect of mind, intellectual, emotional, and impulsive. Under this term we comprehend idiocy, and all the degrees of natural imbecility that may be included in the general term insanity. In its highest degree the mental feebleness is found to be associated with imperfect physical development; and the whole phenomena are, by Feuchtersleben, referred to a depressed cerebral, spinal, and even ganglionic vitality.

Mania is that form of insanity characterized by general perversion of the ordinary mental powers of the individual, so that no aspect of his mind is natural. There is loss of voluntary control over thought, emotion, and action, manifested in delirium, extravagance, and motor excitement. Its phenomena have been referred to cerebrospinal exaltation. Mania has been divided into acute, chronic, remittent, intermittent, epileptic, hysterical, and puerperal, according to certain features in its history. The phrase "moral mania," which you will sometimes meet with, does not imply any variety of mania, being employed to indicate, not a species of general, but of partial, insanity.

Dementia is general deficiency of mental power, intellectual, emotional, and impulsive; not congenital, but the consequence of disease or natural decay. It includes all forms of acquired imbecility, and has the features, but not the history, of amentia. Its symptoms are those of impaired voluntary control over thought, feeling, and action, manifested in incoherence of language, irrational excitement, and a tendency to spasmodic motions and paralysis—phenomena which may be referred to cerebrospinal injury. It occurs as a primary form of insanity in persons of uncultivated or weak mind, but much more usually is a secondary disease, and the result of some other form of the disorder. On the table written up before you, you will find the terms acute, primary, chronic, secondary, and senile, employed to designate its varieties.

Partial insanity is a term which would evidently imply unsoundness of certain of the mental faculties, with a natural condition of the rest; and indeed you will find it so defined by most writers; but it is much nearer the truth to say that it is a more limited exhibition of unsoundness, or a less degree of the same state as general insanity. The mind is so far diseased, that there are one or more intellectual or emotional ideas with which it cannot deal as the minds of other men would do. The judgment is constantly at fault on some point, and the will unfree; but though the points are limited in number, the confusion which they occasion in the mind itself is general, not partial. Partial differs from general insanity, rather in the number of manifested aberrations, than in the number of faculties involved. It also, I believe, may be the result of congenital defect, and accidental obliteration of faculties, as well as a mere manifestation of derangement of powers naturally complete. It may have the character of imbecility or defect, as well as that of confusion or delirium. Two kinds of partial insanity are recognized—viz., monomania and moral insanity, which I shall now briefly define.

Monomania is that form of insanity in which the judgment is evidently incapacitated on certain subjects, yet seems to be sufficiently capable of acting in regard to others. A fixed delusion fetters the attention, overruling the influence of all opposed perceptions, and directing the conduct. The phenomena of the state are referable to a persistent morbid cerebral action. Monomania has been subdivided into a multitude of forms, to which, as you see from the table, various pedantic designations have been applied, intended to be descriptive of the nature of the most prominent diseased manifestations. The best practical division would be, into monomania with depression, in which the delusions are productive of despondency; monomania with exaltation, in which they are such as to elevate the self-esteem of the individual; monomania with alternation, in which the morbid idea sometimes occasions excitement, sometimes depression; and monomania with indifference, in which the phase can neither be said to be of a high nor of a low cast, being of a kind that negatively affects self-estimation.

Moral insanity is that form of the disease which is manifested, not by incapacity of judgment and intellectual aberrations, but by morbid emotions, leading to loss of control and blind or irresistible obedience to disordered impulses. In all cases, though the intellectual power is below the average standard, it is the actions of the individual that are irrational, and not the words; there may be feebleness in thinking, but delirium only in the conduct. The phenomena might be accounted for in the supposition of a depressed cerebral vitality in combination with a state of cerebrospinal irritation. The varieties of the disorder are many; and it is probable that some of them are congenital defects. I would distinguish two kinds of moral insanity—viz., diseased passion, and insane impulse. Of the former, erotomania and nostalgia may be taken as examples, and the latter would include the propensities to suicide, homicide, theft, incendiarism, drunkenness, and unnatural crimes, where such can be characterized as diseased. Feuchtersleben seems to hold that insanity of impulse is just a variety of mania (mania sine delirio,) in which obscure feelings in the nerves of vegetative life—the ganglionic system—acquire such an intensity as to infringe on the motor nervous sphere, and thereby occasion delirious involuntary action.

You will find mention in medical writers of such forms of insanity as fatuity, incoherence, melancholy, brutality, &c.; these are not additional varieties, but merely terms used in place of the foregoing, better employed to characterize symptoms than to construct a classification. There are just five leading forms of insanity—amentia, mania, dementia, monomania, and moral insanity; these form distinct natural groups, though neither absolutely separated nor harshly outlined. From what I stated to you of the relation of partial to general insanity, you will judge that cases of a composite order may be of occasional occurrence. The acquired forms, by which you are to understand all, with the exception of amentia, not unfrequently merge into each other; and instances from time to time appear, of a description so intermediate as to be with difficulty classified. There is sometimes an alternation of one form with another; a case of monomania, for example, assuming, during a casual paroxysm of excitement, the features of mania or dementia. The progress of the disease not unfrequently exhibits, in a single individual, every description of disordered mind. The patient is at first morally insane; then he adopts some particular delusion, and is evidently a monomaniac; delusions multiply, excitement supervenes, the mind acts sanely on no occasion, and his whole aspect is maniacal; finally, this violent cerebral disturbance produces irrecoverable mischief in the brain; the excitement abates, or assumes a chronic type, but the powers of the intellect are as much or more in abeyance than ever, and he falls into the state which is termed dementia—the natural termination of every state of disordered mind which resists the influence of remedies. In the most ordinary mode in which insanity is developed, moral disorder is the first indication of the disease. The patient labors under emotional perversion—is, as it were, morally insane before he manifests intellectual derangement; and the disease not unfrequently disappears by retracing the same steps. The patient has not completely recovered, however unencumbered the imagination and unfettered the judgment, so long as the affections, desires, and sentiments, have not regained their former character and tendencies. Until the cure is thus completed, though the individual should be reckoned sane enough to be competent to his own management, and be liberated accordingly, no one who has had experience of lunatics will regard him as sound enough to be warranted and trusted. Such an one will either acquire additional mental firmness, or be certain to relapse into his former state of disorder, upon the slightest exciting cause, or without the influence of any apparent agency whatever. He will not remain stationary, an example of a man with a new moral character—a second edition, but not improved.

I shall not weary your attention with a separate description of each of the above forms of lunacy. I have already given you certain specific distinctions, and shall now portray the generic features of insanity,—the features which distinguish it from other conditions, and which will be most conveniently taken up, with certain other particulars that require notice, in a *general description of the insane state.*

Diseases of the mind are most common in highly civilized communities, and in countries which have acquired the highest degree of political and religious freedom.

They are also, upon the whole, more common in the female than in the male *sex*,—a fact which is thought, however, to be in some degree affected by station in society. In the higher ranks, according to some observations which have been made both in Britain and in France, lunacy prevails more among males than amongst females. The more sensitive character of the nervous system in females, and their less perfect mental and bodily training, would lead us to expect a great preponderance of them amongst the insane, as there no doubt would be, were it not that the greater prevalence of intemperance and vice amongst men serves to bring up the proportion on the other side nearly to an equality.

As to *age:* insanity is not a disease of early life, nor is it so liable to occur in declining years as when both mind and body are at maturity. The most common period of life for the appearance of insanity is betwixt 30 and 40; rather earlier in the female than in the male sex. About three-fourths of all cases occur between the ages of 20 and 50. Below puberty, insanity is almost unknown, unless in the forms of congenital and accidental imbecility; by which last term I mean imbecility of mind, the consequence of convulsions, fever, or accidental injuries of the head.

The physical *temperament* which shows the greatest tendency to mental derangement is the nervous; the temperament which is least liable is the sanguine. As far as observation has led me to any conclusion on this point, I would say that the greater the mixture of the nervous and the lymphatic temperaments, the greater is the tendency to madness.

All writers concur in representing the married state as more exempted from the danger of lunacy than the state of *celibacy* is,—a statement verified by numerical returns, and still farther strengthened when it is considered that the mean age at which insanity commences is reckoned at 34.* If, then, we were to imitate the phraseology of certain statisticians who speak of "the average man," we should say that the average lunatic is a female about 35 years of age, and of a lymphatic-nervous temperament.

The moral condition of lunatics.—Most of the premonitory symptoms of insanity are evidentiary of a change in the moral constitution of the individual. The best warning is given by a metamorphosis of the natural character, of a permanent and remarkable description. The subject of this alteration has, as it were, turned his back upon himself, and become the opposite of what he formerly was. A diffident and retiring man will be found making some extraordinary exhibition of himself at a public meeting, to the amazement of all his acquaintances; or, perchance, he takes to writing and publishing productions in which he makes manifest to the whole world the symptoms of approaching disorder. I have known the cacoethes scribendi to be a premonitory symptom of madness in many instances; private matters and domestic occurrences being laid before the public in newspaper advertisements, placards, and hand-bills; nor is it an unusual discovery to find an insanely-poetical manuscript in the repositories of one who has just become lunatic. A man whose natural disposition it was to be very timid and cautious in the prosecution of his business affairs, will, in the moral disorder, which gives the first warning of diseased understanding, be found plunging into all manner of rash speculations and hazardous stocks, or even turning projector of the most bold and startling schemes. Changes of profession, pursuits, and religious persuasion, are other modes in which the alteration of disposition and temper manifests itself. A sudden passion for intoxicating liquors, contrary to all former habit, is also not unfrequent evidence of threatening insanity. In short, the sober man often becomes intemperate; the prudent, rash and extravagant; and the sedate and reserved, noisy and wild,—dispositions being acquired which seem opposed to the natural character. Changes, even in a desirable direction, if sudden, unaccountable, and extreme, are equally suspicious. I have known in such circumstances the intemperate to become, not merely temperate, but abstinent; the dull and heavy to seem active and intelligent; the careless, pious; and the timid, courageous; each of these spurious amendments foreshadowing the mental eclipse. Such reversals as described, occurring in those hereditarily predisposed, you may consider as indicative of explosion; and if you act opportunely as a physician, you will lessen the probability of your being required as a medical jurist.

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* In upwards of 1,000 cases of insanity occurring in this quarter of the country,

48 per cent were males.
52 " " females.
75 " " betwixt 20 and 50 years of age.
51 " had the nervous temperament dominant
27 " " bilious " " "
5 " " sanguine " " "
17 " " lymphatic " " "
29 " were married.
7 " " widowed.
64 " " single.

Though a change of this description is the usual precedent of the intellectual disorder, still the moral aspect of the unsound mind is not always of the antipodean character. When insanity does occur without this sort of forewarning, the emotional features of the disease are then as likely to be a caricature of the natural outline of the patient's disposition. Passions which had stamped the mind in the state of health become dominant in a state of disease in which the voluntary power over their exhibition is impaired or suspended,—constantly diminished. The naturally ambitious man, who in his heart worshipped wealth and station, stands forth confessed and bare; he becomes a king, or at least the possessor of enormous wealth. The vain female, whose chief objects in life were dress and adulation, becomes a queen, and is alchemist enough to convert any paltry convocation of rags and straw into a crown. When insanity is marked by the predominance of some one passion, it is more broadly displayed than it ever is in a sane being; and the natural language of the emotion is such as no caricaturist could exaggerate. Such moods are, however, not generic, but special phenomena, and are seen in certain varieties of monomania. Our business at present is rather with those feelings which affect the moral portrait of every lunatic, and of these one of the best marked is selfishness.

Selfishness is one of the most prominent features of the unsound mind. A great many moral defects are comprehended in this term. It implies the decline or destruction of the best part of our social nature, the loss of the sympathetic and benevolent emotions, and, in consequence, a less control over much that is ugly and hateful in humanity. Such feelings seem to be a finer part of the moral constitution, for they are ordinarily the first to suffer from the approaching malady, and the last to be perfectly re-established. "In many persons thus situated," says Dr. Thomas Mayo, "in whom, at the time at which the inquiry is made, the reasoning powers are in a clear and sound state, and whose emotions are flowing easily and quietly, we are enabled to detect disease by observing that the patient is not going along or sympathizing with us, or, indeed, with any one extrinsic to himself. Perhaps his conversation can only be characterized as morbid by its remarkable want of relation to all that is passing in the minds of bystanders. In this point the insane are remarkably contrasted with the inebriated, whom in many points they greatly resemble. Persons in the latter state overflow with sympathy, and carry it to a ridiculous extent." We usually find that alteration or disappearance of the natural affections has been one of the earliest symptoms that attracted attention. In a lunatic you will generally observe that the ties of consanguinity are snapped, and that no interest is manifested in the welfare of friends; the mother may have forgotten her child, and the wife her husband. It is well if the loss of affection have assumed no other than a passive character, for it very frequently happens that they to whom they most owe affection are those whom the insane visit with their hatred and their violence. To them their fancied ills are attributed; but even when their relatives are not mixed up with their delusions, they are usually treated with aversion or with apathy. Not only are the natural affections lost in the overwhelming tyranny of selfishness in the insane mind, but so also are those social feelings which unite men to each other. Kindness, friendship, and sympathy, are not amongst the virtues of the insane. In an asylum you will not find much association among the inmates. It is no uncommon thing to see, in a confined airing-yard, twenty or thirty people walking about, and no two keeping company together; and in a day-room of lunatics there is very little conversation. Each one is willing enough to speak of his own delusion, or to discuss the particular injustice of his own imprisonment, but he has neither ear nor heart for the complaints of his fellows. They are under circumstances which might be expected to bind men strongly to each other, but they are not so bound. They are under circumstances which the multitude of them deem to be the consequences of unheard-of injustice and oppression; and with this powerful incentive to social action they are directed, controlled, and superintended by a very few, without ever attempting to regain the freedom which they all desire so much by any effort of co-operation. They do not combine or conspire together, not from want of intellect, but from the decay of all social and sympathetic feelings. In many hospitals the walls are so low that, though they prevent an unaided person from escaping, they are quite capable of being scaled, if the person making the attempt had only the aid of one sympathizing individual; yet the insane never make their escape in this manner. The lack of the benevolent affections miserably curtails the happiness of life; and since so many of the insane have, from this moral deficiency, no active sensation of happiness, we cannot wonder that a propensity to self-destruction is so common amongst them.

General description of the insane state (continued.) (a) The moral condition of lunatics (concluded.) — Their selfishness, suspiciousness, timidity, and apathetic listlessness.— (b) The intellectual condition of lunatics—manifested in deranged voluntary power over the succession of thoughts, in delusion, imbecility incoherence, and extravagant conduct—disturbed relation of will to thought. Delusions —their origin in violent mental impressions—their hold on the belief—their resistance to interfering doubts—their absorption of the attention—most distinctly defined in monomania—concealed delusion—delusions an insufficient test of unsoundness —divided into high and low. Subjects of exciting delusions—their insufficiency to produce happiness. Subjects of depressing delusions — Thanatophobia —Panphobia — Hypochondriacal monomania — Demonomania, &c.—relative frequency of high and low delusions—modifications by sex, temperament, education, and bodily disease.

In my last discourse I had commenced a general description of the lunatic state with the consideration of the moral condition of the insane. I described the peculiarities of that emotional derangement which is ordinarily a fore-warning of diseased intellect, and, in depicting the features of the fully developed disorder, alluded at some length to the morbid predominance of the selfish feeling, which, owing to the loss or depraved state of the sympathetic or benevolent affections, is so constantly observable in the insane. The consequences of this mental obliquity are for ever prominent in their language and behaviour, and it leads besides to the unmasking of the evil passions of human nature, which, owing to the impaired voluntary control accompanying the disease, too frequently start up in ugly activity. In saying that the insane are morbidly selfish, I use a term of very wide significance, which, as it were, epitomizes their moral condition, leaving very little to be added.

Suspicion is another feature which is pretty constant in the emotional aspect of the insane. Mistrust is said to be a natural characteristic of feeble minds, and to be the lot of those whose understandings have been but little cultivated; and it would also seem to be as natural a concomitant of mental disease. "The heart of the insane," says Esquirol, "cherishes no feeling but mistrust. This symptom increases with the progress of the disease, and augments in strength as the intellectual faculties are weakened. Yet notwithstanding their mistrust," continues he, "the insane have no foresight; they have no care nor inquietude for the future, but an extreme jealousy of everything present."

This suspiciousness of mind, this constant imagining of evil, is exhibited in a multitude of delusions. Cabals and conspiracies are suspected to be formed against them by those whose good intentions there seems least occasion to doubt. Food is carefully inspected, lest it should be poisoned; to every unusual action in those around them a bad motive is attributed; and the overheard common-places of ordinary conversation are twisted and tortured into an evil meaning towards their welfare. A female lunatic persisted in living solely on a vegetable diet during her illness, and no persuasion nor temptation could lead her to alter her resolution. After her recovery, I found that the reason of this conduct was, that she suspected the officials of the asylum in which she was placed to be in the habit of murdering the incurables, and victualling the establishment with their bodies.

There are some cases in which the whole unsoundness seems to consist in unreasonable suspiciousness: it forms not an uncommon variety of monomania in advanced life. An old lady makes herself exceedingly miserable, by the baseless delusion that she is plundered and cheated by servants, neighbours, and indeed any one with whom she has had any dealings. Within doors, no number of locks and no ingenuity of fastenings are sufficient to give ease to her mind; every box and drawer is not only locked, but padlocked to boot; and when these are opened by herself, and every article is found in the exact relative position in which she had placed it, she has still the belief that her repositories have been entered, and her property changed for similar things of a less valuable description.

It is with the utmost difficulty that one can satisfy a lunatic of the sincerity of words and intentions, and a request he looks upon as a snare. The superintendent of an hospital for the insane wished, for a special and very harmless purpose, to have the autographs of his patients. He found that he had undertaken a very difficult task in attempting to get them to comply with his proposal. He could persuade very few to subscribe their name without a great amount of trouble Some signed hesitatingly; some repented when the deed was half done, or threw down the pen after they had taken it in hand; one signed his name upside down; another effaced his as soon as he had it completed; and many refused to have anything to do with such a dangerous proposal. The document was a very curious one in many respects, but not the least interesting feature in it was the evidence it contained of that suspiciousness of disposition on which we have been commenting.

So much suspicion is not compatible with a high degree of courage, and you will accordingly observe that an unnatural degree of *timidity* is one of the defects of the unsound mind. Patients in a state of maniacal fury may be found to encounter, blindly, any sort of danger, but all other kinds of insane persons are very easily alarmed. Those of them who are characterized as dangerous lunatics are more malignant than ferocious. The ferocity which, in times not long past, led to the imposition of chains and fetters on the insane, was the lie of ignorant, timid, and lazy keepers, or the result sometimes of their barbarity. You will find neither whips, chains, nor danger, within the walls of any of our British asylums.

An *apathetic listlessness* is another prevalent mood in the insane, though one of a negative kind, having its origin in a general anæsthetic condition of the senses, combined with an enfeebled memory and abstracted or decayed attention. Unless in maniacal cases, in which there is a morbid degree of activity, the desire of action is generally lessened, often entirely lost. The sound body cannot endure the tædium vitæ of idleness, neither can the healthy mind brook want of occupation. A man must have some occupation to withdraw him from himself, or, says Pascal, he is necessarily unhappy. Now the insane are almost constantly occupied with themselves, to the manifest increase of their misery. The desire of employment is very difficult to be excited in them; they will not exert themselves either to be useful or to be amused; and curiosity, one of the marks of an active and healthy mind, is, as in some of the lower savage races, very much in abeyance.

One hears a good deal of balls and parties in lunatic asylums, and we have wondrous paragraphs in newspapers, mere puffs by vain superintendents or silly directors, describing how extra-sane and supremely happy all the proceedings were, or if any slip were, how pleasantly outré. Now having seen not a few of such things in various places, I can assure you that no ball in a lunatic asylum was ever worthy of the name; as how could it be, with the absence of such necessary elements as health, humour, wit, activity and contentment? In making this remark, I by no means intend to reflect in an unworthy spirit upon such attempts; they are most highly to be praised, if judiciously managed and not injudiciously blazoned. Such is the listlessness of the great body of lunatics, that to succeed to get them either to occupy or to amuse themselves is the hardest employment of those who have them in charge, and the one for which the highest commendation is deserved. Ennui is not a pain felt by an unsound mind. The monomaniac's delusion is his constant thought and his sole thinking: his feelings are of one complexion: he is insensible to the languor which would arise from an unvaried feeling in a healthy mind. Ennui is a hopeful complaint in the insane, for they are in a position, says Esquirol, which is adapted to render it like an active sensation that will usefully react upon their thoughts and affections.

The intellectual condition of lunatics.—In the analysis of the human mind, two things are observed to constitute mental consciousness, viz.—thought and will. The first represents that unfailing train of ideas which have their origin in an accidental series of external impressions on the senses, or which, if not ab externo, are connected together by certain laws of association. They consist of instinctive inclinations, emotional feelings, intellectual perceptions, and primitive rational intuitions. The second (will) represents the consciousness which we have of a certain amount of power in controlling or affecting the succession of thoughts. This voluntary faculty does not create ideas, it merely selects, detains, and operates upon, any particular idea of the many that crowd upon the mind. It is by this relation of our will to thought that thought becomes thinking; desire, action; and abstract mind, personality. The agency of the will is apparent in such processes as attention, judgment, and recollection, which are, in truth, voluntary contemplation, alternate and retrospective; but indeed the voluntary faculty is the essence of all intellectual operations whatever.

Now, in the various forms of intellectual unsoundness, both these principles seem in every case to be affected, though it would be more strictly correct to say, that it is the relation of the latter to the former that is disturbed. The succession of ideas is more rapid than natural in maniacal excitement, more slow than natural in melancholia (monomania with depression,) and uncontrolled by its natural laws in dementia. The voluntary power over trains of thought is defective in all cases. In mania it seems overpowered by the force and rapidity of the current; in melancholia, enfeebled by the one vast and gloomy image that has dammed up the whole channel of thought; and in dementia, permanently impaired.

Such a condition of the mind may occasion diseased manifestations of any or all of the intellectual processes, and it would not be difficult to select examples of disordered sensation, perception, attention, memory, conception, and so forth, occurring in lunatics: but the defect which is most characteristic of insanity is, as I have formerly stated, an inability to exercise the faculty of comparison, so as to evolve judgment upon one or more subjects, that incapacity being a direct consequence of impaired voluntary power over thought. In addition to such other evidence of disease as misinterpreted sensations and conceptions, rivetted or distracted attention, and way-ward and irresponsive memory, there is this distinct impracticability of judgment, before there can exist an insane delusion.

When the *intellectual* signs of madness become apparent, the premonitary stage is past; the disease is fully developed. The morbid intellect of insanity is displayed in delusion, inexplicable conduct, mental feebleness, and incoherence of language,—pathognomonic features which I shall now successively discuss.

Delusions are very generally but not universally to be observed in lunatics. They are, as you will recollect, illusions and hallucinations, governing the conduct, despite the will, despite the reason. They are idealities accepted as realities. They are errors of perception consequent upon the disordered sensations and disordered fancies, to which a diseased state of the psycho-physical relation renders the mind liable.

Violent mental impressions are the chief originators of delusion. Take the following example, which I borrow from the plentiful store of Dr. Conolly's experience. A clergyman opened a letter that was handed to him, and swallowed the seal. A friend standing beside him said, jestingly, that it might seal up his bowels. This made a startling impression on the clergyman's mind; the notion of his bowels being sealed up was a horrible one, and, spite of himself, kept forcible possession of his thoughts, engrossing his attention so violently that his will became unable to dispel the conception. The attention could not be brought to bear upon any other subject, and, if removed for a little, constantly recurred to the disagreeable idea, until at length the conception acquired all the force of an actual sensation, and came to be believed in as a reality. The power of instituting an efficient comparison on this point was lost. No quantity of purgative medicine, operating however naturally, could prove to him that his intestinal canal was not actually closed up. There was no judgment in the matter, and he became a monomaniac with this particular hypochondriacal delusion. Here, then, you observe, first, a diseased intensity of conception; secondly, rivetted attention; thirdly, diminution of the voluntary power over the thoughts; and lastly, abeyance of judgment and insanity.

A morbid impression thus completely established—converted into a delusion—has stronger hold of the belief than any impression that an actual sensation could convey. A lunatic believes in his delusion more firmly than ever he held by the truth of any real object of sense. The possibility of being deceived he cannot admit; he will sooner admit all other accredited realities to be deceptive. Those senses which act soundly enough have no power to correct the error. Sir Walter Scott relates the case of a poor lunatic in the Edinburgh Infirmary, who fancied that he was living in great state and splendour, in a mansion of his own, his only unhappiness being, that all the dainties with which his table was supplied had the taste of porridge. The palate acted an honest part, but its appeal to the judgment was quite ineffective. Any degree of doubt which may arise in an insane person's mind regarding the reality of his fancies, is of a peculiar sort, and exerts no influence, or only one of the most transient and feeble kind. "I had a species of doubt," says a recovered maniac, describing what were his feelings, "I had a species of doubt; but no one who has not been deranged can understand how dreadfully true a lunatic's insane imaginations appear to him, how slight his sane doubts." A patient of Dr. Conolly's was the subject of delusions which he occasionally suspected to be delusive, and yet he could not deliver himself from them. He supposed that he had entered into pecuniary engagements with a friend, which would occasion his total ruin. His words were, "I know I have not, I could make oath that I have not, and yet I cannot get rid of the impression that I have; and I am continually haunted with the dread of coming to the workhouse." This idea had led his thoughts towards suicide. He had tried in vain, and frequently, to get rid of the delusive impression by the exercise of reason, and felt conscious of the want of some help. "I think," he would add, "that I must get my friend to write me a letter, assuring me that I have not made this ruinous agreement with him; perhaps that may convince me." "But," says Dr. Conolly, "in these cases, until the morbid state is removed, conviction seems inadmissible by the mind: a man will send for his banker's-book, see that he has a large balance in his favor, and persist in saying that he is not worth a farthing."

The delusion of a lunatic is not an occasional but a constant error of mental action. "It is the dominant idea in his mind," says Dr. Pagan; "it is not a subject which occupies no more of his attention than its interest would seem to claim. He does not merely think about it erroneously, but it is *ever* present to his mind; talking, he speaks of it; silent, he thinks of it; sleeping, he dreams of it. No other subject has a proportional share of his attention; he has no sympathy for other men's interests."

Monomania is the form of insanity in which delusion is most distinctly defined. In the other varieties it is frequently difficult to point out any fixed governing idea. The maniacal are in a state of delirious excitement, in which everything wears a strange aspect, and the judgment cannot be brought to bear efficiently on any one idea. Their delusions are constantly varying with surrounding circumstances, and have no marked persistence: an insane notion arises, disappears, and is replaced by some other idea equally unsound, and possibly inconsistent with its immediate predecessor.

In monomania there is one particular, fixed, and dominant delusion, or there are a set of relative subjects on which the patient always manifests his derangement. If he think himself a king, for example, he may be comparatively rational on all matters unless those which connect themselves with the idea of his royal condition. But even in monomania, a delusion absolutely and persistently single is a rarity; for, by and by, the intellectual blemish is well seen to be surrounded by other marks of unsoundness, no longer latent. It is not, as ordinarily stated, that one delusion produces more; that one maggot generates another; the single intellectual error extending its influence like a morbid virus. I have already told you that partial insanity as opposed to general is not a true phrase: it is only the exhibition of unsoundness that is limited. The single delusion is but the first manifestation of a mind as wholly unsound, though less intensely, as that of the bewildered maniac. However, be this as it may, true it is, that, when you have a single delusion, the chances are that you will have many more evidences of disease. There are few monomaniacs in whom the mind acts with vigor and soundness on subjects even widely removed from that of their delusion.

An insane person sometimes seeks to conceal the existence of delusion. I believe I may add that he never succeeds. There are such things as concealment of the nature of the delusion; but that some delusion exists in the mind is always in some measure expressed in habits and conduct. The attempt at concealment is to be witnessed only in cunning monomaniacs, who have become aware that they are deemed insane. Monomania is, however, the very form of insanity which gives rise to judicial difficulties, and in which it is of the greatest importance that the existence and character of the dominant delusion should be clearly displayed. I have more than once known such a lunatic to conceal the cloven-foot so successfully as to impose upon a most competent and persevering examiner, who was ignorant of the particular point on which the power of rational discussion was impossible. The insane often appreciate the motives which ought to lead them to hide their aberration, and are well aware of the subjects on which it is necessary to exercise concealment, in order to pass muster as sound in mind, but for all this they seldom or never succeed in concealing their delusion when they are directly questioned regarding it. The most that a lunatic desirous of passing as sane can in general effect is not of himself to introduce the subject on which his judgment is alienated; but when he is expressly catechised upon it he either refuses to answer any queries regarding it, which is to him a very great effort, or he certainly stumbles in his replies, and makes evident the unsoundness of his understanding. An insane lady had so far imposed upon a philanthropic visitor of the asylum in which she was confined, as to lead to a private and influential representation to the sheriff that she was unnecessarily and unjustly deprived of her freedom. The sheriff accordingly called unexpectedly at the hospital, and had a private audience in order to satisfy himself of her condition. She answered every question in so rational a style, as to afford no apparent grounds on which her liberation should be refused. Upon consulting the case-book, however, he found that she was said to entertain the belief that she was the Duchess of Wellington, or at times the Baroness Rothschild. Having obtained the key to her mystery he held a second conversation with her, when, in spite of her anxiety to impose upon one whom she knew to have the power of terminating her confinement, she exhibited such evident insanity, that he left her apartment holding up his hands in amazement. She could not resist a direct interrogatory upon her rank of Duchess.

Common as delusions are amongst the insane, they are not prominent, nor possibly even existent, in every case of the disorder, and therefore the absence of delusion is no test of soundness. Delusion is merely one indication that the disease has extended to the intellectual faculties, and is therefore no test of mere imbecility, of moral insanity, or of the first stage of many cases both of monomania and mania.

It is usual to divide the delusions of the insane into *high* and *low*, or *exciting* and *depressing*, according to the mode in which they affect the patient's self-esteem. What is commonly called a depressing delusion may be conjoined with both mental and corporeal excitement, and a high delusion may exist with much apathy of mind and debility of body.

Most of the high delusions of the insane consist of ideas of imaginary rank and wealth; of over-estimation of mental and bodily powers, and of imaginations of a less sublunary kind, leading the subjects of them to consider themselves as inspired by Heaven. However elevated the insane idea may be; and however much calculated to render the possessed of it independent of the influence of immediate and surrounding circumstances, it is very seldom a source of happiness and comfort. Such high notions seem always to cast a shadow on the mind; there is a hollowness in the happiness such as interferes with the exalted fancies of feverish dreaming, and a frequent recurrence of moods of depression, which are little consistent with the professed state of beatitude. As a class, lunatics are persons experiencing a great amount of misery: the feeling of pleasure is rare amongst them; laughter is almost unknown, at least as the natural language of joyous emotions; and it is only among some of the imbecile that unhappiness is neither expressed nor seen in the countenance or the conduct.

The low delusions are of more various kind, and require more special description. In this list, prospective feelings of dread, retrospective and present suspicions, hypochondrical miseries, and terrors of the future state of existence, form the most remarkable groups. The dread of being killed by their enemies, or of suffering death by the hands of justice for some form of fancied guilt, is a common species of delusion amongst the insane (*thanatophobia*,) and one which it is well to be aware is perfectly compatible with the desire of killing themselves, and which is indeed very usually associated with the propensity to self-destruction. Many are overshadowed by some impending and gigantic evil, vague, but dismally real and irresistible, which they cannot describe. Every object wears a threatening aspect; they feel terrors unaccountable; their hearts are sunk within them; tears are scarcely ever from their eyes; and their whole occupation is to watch for the bursting of the dark cloud that is to destroy them for ever (*panphobia.*) Some live in the constant dread of poison mixed with their food, administered instead of drugs, placed upon their clothes, hidden in their beds, and poured into their ears, or administered per anum during sleep. Others labour under the fear of future want, and, with no ground for anxiety, believe that they are on the high road to destitution and beggary. Their past circumstances seem like an experience of purple and fine linen when compared with their present condition; and the future they regard as a vision of sackcloth and starvation: such misfortune has been brought about by enemies who have plundered and cheated them, or has come upon them, by the vengeance of heaven, as a punishment for sins. Domestic jealousy is not an uncommon character of the insane delusion, particularly amongst males. Men are also more subject than females to another imagination which is a frequent accompaniment of lunacy,—the conviction that they are the victims of a widely-extended conspiracy. Every one with whom they come in contact is sure to become concerned in the great plot which is hatching against them. Macnaughten, the lunatic who assassinated Mr. Drummond, was a monomaniac of this class. For many years he had imagined himself an object of persecution, first to the Jesuits, then to the whole body of Roman Catholics; these were latterly joined by the Police, and finally, he believed, by the whole Conservative party. There is a numerous class of the insane in whom strange bodily sensations give rise to the notion that they are the subjects of strange pathological conditions, or of actual physical metamorphosis (*hypochondriacal monomania.*) The sexual organs are very frequently the subject of hypochondriacal delusions among the insane. Obstructions of the intestinal canal, displacement of viscera, the sensation of living animals within the cavities, and various monstrosities of external appearance, are also common imaginations in this class. Depressing delusions connected with religious subjects are very frequent, particularly amongst the female insane. Such persons are beyond the power of salvation, are under the curse of the Deity, have committed the unpardonable sin against the Holy Ghost, have directly bartered their soul to the evil one for some worldly pleasure or advantage, or are actually already in the state of eternal torment. Witchcraft, and various forms of unseen agency, are other subjects on which the insane often manifest their lack of judgment. They have been permanently injured by the incantations and evil prayers of others; their thoughts, words, and actions, are not the effects of their own individual will, but are the devices of external machinations, or are the doings of evil spirits around them, or within them. Now and then a patient will be found who has the painful fancy that he is actually possessed by the Devil, that his soul has been taken from him, and that Satan himself has taken possession of his frame (*demonomania.*)

Delusions are liable to be modified by such circumstances as sex, age, temperament, education, and bodily disorder. Depressing fancies are much more common than those which are called exciting. In 287 instances of monomania, I found that the low delusions amounted to 168; the high delusions to 76; and those which were of an indifferent order to 43. High delusions were more frequent in the male than in the female sex. The only temperament in which they relatively predominated over those of a low type was the sanguine: in all the others, particularly in the lymphatic or deteriorated sanguine, depressing imaginations were the more numerous.* High delusions have a tendency to be transformed into those of a depressing character. Education modifies the nature, but more strikingly the expression, of insane convictions. An intelligent person, for instance, will not be found styling himself "the fourth person of the Trinity;" nor will an educated female write her name "Margaret Rex." The sensations which compel an ignorant lunatic to express his belief that he has been bewitched, would, in one above superstition, lead to the notion that he had been brought under the influence of some kind of magnetic or mesmeric agency. Bodily disorder may, there is some reason to think, produce a modifying effect. Disease of the lungs, or of the encephalon, are more likely to be conjoined with delusions of a high cast, than those of the kidneys or heart are. Almost all cases of insanity which are threatening apoplexy or paralysis, are associated with high delusions. In those cases, also, which are complicated with the peculiar paralysis of the insane,—an insidious general palsy,—exciting fancies, are nearly universally observable. Such persons, while they are scarcely intelligible, from defective articulation, while they are passing their urine involuntarily, and staggering with extreme difficulty from one chair to another, still have a shattered physiognomy of happiness. They are in a paradise of excitement, leading armies over Alps, or dispensing the riches of India. When death is making daily approaches upon them, they are in a state of miraculous health; and when they are in his very clutches, they are in the arms of victory, or the glories of Solomon's temple.

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* In 244 patients in whom the modifying influence of temperament was observed, the following ratios existed:—

	High delusions per cent.	Low delusions per cent.
Aggregate cases,	31	69
Nervous temperament,	30	70
Bilious, "	26	74
Sanguine, '	60	40
Lymphatic, "	8	92

General description of the insane state (continued.)

(b) *Intellectual condition of lunatics (continued)—Imbecility of mind—manifested in various habits and actions—exemplified—Imbecility in thinking—exemplified in writing—intellectual disorder increases with the prolonged effort at control—a lunatic's views of the insane conduct of other lunatics—may be aware of his legal position—the characteristics of lunatic epistles—exemplification of the expression of delusion. Incoherence—not a form of insanity, but a possible symptom in any form of the disease; best marked in mania and dementia—incoherence in monomania. Extravagance of conduct—the result of delusion—exemplified—motives not traceable in insane actions—criminal deeds of the insane not indicative of viciousness—unsuitableness of insane actions to proposed object.*

Imbecility is the next mental characteristic to be noticed; but, before alluding to the intellectual indications of it, I may specify some common actions and propensities in the lunatic state that manifest a general weakness of mind. In many, tears flow from very slight emotion, just as may be usually observed in cases of paralysis; and some are shaken by violent fits of laughter, apparently without any adequate reason. Laughter from slight or no cause is not an uncommon symptom in dementia—more common, perhaps, in female than in male lunatics. This risable propensity indicates no appreciation of humour: an indifferent impression on any of the senses may induce it: the sight of a stranger—a word spoken when there is silence—or even the motion of a finger. I doubt in many instances whether the laugher is even aware of his own mirth.

Weakness of mind is seen also in a childish facility of being pleased with trifles, showy articles of dress, silly ornaments, and other things which, offered as consolation, a sensible understanding would despise, but which in a lunatic asylum are daily found advantageous in assuaging grief and conferring temporary pleasure. It requires no little attention to prevent many of the insane from making their personal appearance ridiculous by their dress. When they were more generally at large than they are now permitted to be, and when every village could show its fool, these poor objects could be distinguished by strangers by the monstrosities of their apparel.

Some lunatics exhibit a strange propensity to collect and amass together all sorts of unconsidered trifles. I was taken by an old man who had this craze to a small outhouse in which he had collected a treasure of this sort, in which his whole soul was so much engrossed as ever a miser's was in his money, or a biblio-maniac's in his books. The collection, if not admirable for its value or rarity, was astounding for its extent and variety of absolute rubbish. Pieces of old rope, filthy blacking-bottles, broken crockery, rusty iron, hens' feathers, showy rags, buttons, fishbones, and a variety of other matters which had by oversight escaped the dunghill, were there laid up for admiration, and were esteemed by their collector a most attractive and imposing spectacle.

Certain demented persons find a childish amusement in jingling together words of a like termination. I have heard some of those who exemplified this whim go on making rhymes for an hour at a time, the similarity of sound in certain words seeming to be the only object in their continued utterance of an incoherent rhapsody. Others will go on reiterating some unmeaning convocation of words or phrases for the greater part of a day. I recollect one instance in which the attention to the sound of words took rather a singular form. The individual had become fascinated in some way by the sound of the vowel O, which he marked energetically whenever it occurred in his speech. This was, however, not so much an indication of mental feebleness as of obedience to an out-of-the-way delusion. He had the idea that there was a spell upon him impelling him to use this letter, and was no easy man to converse with, for he got furiously displeased with those that spoke to him if his ear detected the frequent recurrence of this vocalism in the words which they employed.

Feebleness of mind, instability of attention, and loss of self-control, are apparent in most things which lunatics attempt. The endeavour to instruct them in any new thing is a very difficult business; and, unless in so far as it aids the moral treatment of the disease, very unsatisfactory in its result. Occupations of various kinds are now carried on in all good lunatic hospitals; but one sane workman would be able to work against two or three lunatics, and his work, under similar instructions, would be superior in quality as well as in quantity.

It is not an unfrequent thing for a lunatic to sit laughing and talking to himself without being aware that he is so occupied. I remember one particular example of enfeebled mind in which the chief feature was that the patient, when left to himself, fell to talking aloud, his speech being sometimes at the full pitch of his voice, and the matter of it anything but agreeable to those who were within earshot. His talk, besides being noisy, was highly obscene, and rendered him such a nuisance both to his own house and the neighbourhood, that he was sent to a lunatic asylum. I found that in general he was not even aware that he had been talking at all, and when checked he would deny that he had been speaking ever so softly. When the matter of his discourse, however, was represented to him, he then allowed that he had been *thinking* in the way described, but persisted that if he gave utterance to his thoughts he was not aware of it at the time. He coined his thoughts into words without being sensible of his so doing. A person in such a state gives vent to much greater incoherence than his conversation ever manifests; and, accordingly, this gentleman, though evidently of enfeebled mind, was capable of conversing in a rational manner, and for any length of time, but the soliloquy of his solitary thoughts was a most lunatic rhapsody. The act of conversing with such an individual serves the purpose of steadying his thoughts, the part which a second person bears in the conversation affording points of direction and support to the vagrant attention.

Imbecility in thinking is always in a greater or less degree the accompaniment of insanity. The ideas of the insane become objects that they are no longer able to deal with by voluntary effort. Volition has not weight sufficient to make such an impression as will regulate their course. Unless the ideas can be effectively dealt with by the natural amount of power in regulating and controlling their succession, the processes of attention, memory, and comparison, must be impaired, involving with them the faculties of abstraction, imagination, and judgment. The very endeavour of a lunatic to influence the current of thought serves often but to increase the confusion; and, if he manifests imbecility in thinking in conversation, in which he has the directing aid of another, he is likely to make that imbecility still more apparent when he is left to himself, and allowed to attempt giving utterance to a chain of connected and related thoughts. The attempt to write upon any subject is the one which will render the intellectual derangement most plainly manifest; and, in a medico-legal view of insanity, it will not be throwing away your time to give a few examples of failure in converting thought into thinking, and thinking into words. These I select not so much as being the most characteristic that might be given, but as the most convenient, from their brevity, and the absence of circumstantial and personal allusions. You are to understand that they are examples rather of special than general lunacy, and also that they are the production of those whose education and acquirements enabled them at one time to make a very different exhibition.

A gentleman whose mind had fallen into a state of feebleness, the consequence of a previous maniacal condition, but who could in the slighter effort of ordinary conversation manage to pass muster tolerably well, thus displays his inability to deal with his thoughts when he attempts to write a short letter. His object in the example which I am about to give seems to me to be to express something like the following ideas:—I have no particular object in writing to you at present, unless to take advantage of our former intimacy, and to prove that I consider it a duty to remember you; and I hope that, whatever circumstances occur, we shall still continue to have the same friendly feeling toward each other. Such may, I think, be considered the aim of the epistle. It would be a weak mind that would resolve upon sending a letter with no other object than the above, unless it were to be made a longer and more interesting communication than such a brief statement would be. The way in which he succeeds is this:—"My dear sir,—I cannot but exercise a reclaiming petition in my favour, and therefore bring to view the social intimacy in which we formerly stood connected, and in compliance soften the obligatory duty. We may still aspire to a tangible hope at least to meet the crisis of passing events, and in fellowship conciliate our conditions in like manner. The confiding heart will then furnish its results to a merited condition. With the basis of these propositions, suffer me to conclude, with the greatest esteem, your dutiful friend, &c."

Here is another instance of a similar kind:—

The patient, in consequence of having received a visit from an acquaintance who invites him to pay a visit in return to his house, thinks it necessary to make a written acknowledgment of so much attention, and acquits himself as follows:—"I was particularly happy at the pleasure to see you last day, and more particularly the most discriminate satisfaction to learn of the manifest surety of all terminating to a good effect." (His friend had probably consoled him with the assurance that he would regain his health and freedom.) "I cannot too much estimate the agreeable confidence reposed in me, and the marked attention so constituted of the family, and even friends. This ought to give me a conviction of the good society and ability of influence in point of politeness with whom I judge versed to form acquaintance. If I could see your place I think I should find it curious." (This is not a piece of naïveté in allusion to his restricted freedom, but merely his mode of saying that his friend's residence was well worthy of a visit.) "My motive would be chiefly to see it both as regards natural and that of superficial connection as to improvement. I beg to be most kindly remembered, and I am, &c."

It usually happens that the confusion of ideas gradually increases with the prolonged effort to express them. The first replies of a lunatic to a course of questioning constitute the best exhibition of his faculties; as the conversation continues, the replies become more and more insane in their character. The same thing is often exhibited in writing. The following is rather an amusing example:—One of the gardens to which the patients in a lunatic asylum had access having fallen into a state of disorder from neglect, an inmate who had something of a taste, though an insane one, in horticultural matters, chose to make the following report on the subject:—"In regard to the southern airing ground," writes he, "the shrubberies and flower-pots would be much improved by some attention to the same; therefore the rose-mounts might have a little manure added to the soil, as this appears to be the primary point with respect to these, and cleaned out, and the roots kept free of each other as well as the bushes. The general effect otherwise may speedily be got in trim, when it may form altogether a free and genteel aspect. The box edging may also form an important source of interest to the occupiers by doing it neatly, and at the same time not to lower their proper estimate of themselves as subsidiary exercise for a short time. No doubt it would have been in better order had it not been

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for the injuries it sometimes receives by the poor invalids that practise their much to be deplored folly; but when the heart of influence has got an acting corrective guide, it sweetens every effect to impress the mind with the beauties of nature and the direction of man, generally speaking." The reporter gets on very well for a short space, but ultimately loses himself in a maze of words. The "much to be deplored folly" so complacently referred to, and which in the epistle is the initiatory phrase to the deplorable folly of the writer's own words, shows that a lunatic may be perfectly aware of the insanity of his companions, though insensible to his own deficiency.

It is, however, not an infrequent evidence of the diseased imbecility of the intellect to find that the lunatic is not cognizant either of his own or of others' delusions. He is unable to discover anything extraordinary in the conduct of those around him. A maniac he considers to be a very lively person, something too much so perhaps; but he is not struck by anything irrational in his behaviour. It is often the first mark of convalescence for a patient to become sensible to the absurdities of his companions.

I may here direct your attention to the fact that lunatics, though blind to the defect of their own judgment, are often sufficiently aware of the estimation in which they are held by others, and have a perfect knowledge of their irresponsibility in the eye of the law. For example, a lunatic seeks to gain his freedom by bribing his attendant with a promissory note for a considerable amount, and in a private communication to one of his friends tells what he intends to do, remarking that of course there is no danger of loss to be apprehended, for that his position incapacitates him from being lawfully a party in any agreement. This might be pleaded by the patient's curators or his heirs, but not at any time by himself; for it is a principle in law that no man shall stultify his own acts. Not long ago, under my own observation, an insane patient made the attempt to destroy the life of his attendant, who was at the time in a stooping position, by suddenly snatching up a spade and aiming a blow at his head. Manslaughter, he said, was of little consequence to him, for no madman is punishable by law. You will find many instances of a similar kind on record, and in regard to them all you will notice that they occurred in persons who knew that they were considered to be insane: indeed, they are all related of patients under restraint; and such speeches do not indicate that the individual is aware of and believes in his own madness, but only that he knows that he is accounted insane. No person, therefore, who falls suddenly into the state of mental derangement and commits a deed of violence, can be supposed to do so because he knows that he will be exempted from punishment on account of the state of his mind. A criminal lunatic does not believe in his own insanity at the time that it is pleaded for him by his counsel. He may become aware of his legal position only when experience has taught him how his conduct is judged of by the world.

The following short attempt at letter-writing is a lamentable example of imbecility: it was nearly the forenoon's occupation of one who was in his time reckoned a very clear-headed and intelligent professional man:—"Dear sir,—You are directed pull down all authorities municipalities and powers in which I am invested, and to regard me as extinct and not monumental. You are feudally you hereby required to remodel all authorities powers and dignities but not you are in my name not for the space of five days less or more not exceeding ten years but not in my name not not.—Yours, &c." The production, to be duly appreciated, would require to be seen. It evinces, besides delusion, great decay of the faculties of attention and memory, and an extraordinary inefficiency of the voluntary power over the current of thoughts.

Though the examples given are all of a brief kind, you are not to suppose that brevity is the characteristic of insane epistles. And here I may take the opportunity of making a few observations on such productions. The letter of one labouring under mania will bear every possible evidence of his condition. The handwriting will not be like his ordinary handwriting; the page will be blurred, blotted, and disfigured; the words frequently misspelled, omitted, and misapplied; the letter probably grotesquely folded, and put up in some absurd way; and the matter rhapsodical, incoherent, and influenced by his delusions. Such a communication is not likely to be very long. On the other hand, the letter of a monomaniac will probably be very much the opposite of terse. A monomaniac, as he never wearies thinking or speaking of his delusion, does not condense when he comes to deal with it in writing. Such a letter, while it may be tolerably connected, and manifest possibly considerable activity of mind, will usually be found to be of a most extravagant length. He knows no limitation but the amount of paper he can at the time command. It will be like a web of inky tartan, crossed and re-crossed; warp and woof of it covered with his insane crotchet,—his insane crotchet alone. Many of the partially demented have also a great plenty of words,—so great, that they could apparently continue writing for ever. Such productions are distinguishable from the prolix communications of the monomaniac by the constant incoherence of thought and language displayed in them. When the imbecility of mind is great, the epistle is very short, from evident want both of ideas and words.

The epistles I have adduced have exemplified the intellectual feebleness of the insane, rather than their diseased imagination and loss of judgment. I shall now finally give you one example of the expression of delusion: it is to this effect:—"A mutual friend informs me that he was with you this morning, and that you was expressing a desire of hearing from me. It is a very long time I have been here, almost fifteen years. I have seen you twice. If you would give me a call occasionally I would take it as a favour. For what reason have I been here such a length of time? As a madman or an idiot? No! There is not a madman or an idiot here, and has not been during the time I have been here. For what purpose, then, are they or I here? Am I here voluntarily? What say you? You know I am not. We who are here are all operated upon by zinking mechanicals. I should think by this time the nature of these is in some degree known beyond the walls of this place, and that yourself know something of them. Their operation is now general over the whole earth, from pole to pole, and from east to west. Of the structure of the mechanicals I am ignorant. A chief part of them, I understand, is under the surface of the earth. From information given me through my own mouth by some of those persons who operate by means of these mechanicals, I understand that this globe is not a spheroid, but of the shape of a kettle-drum, an instrument used for music. The crust does not in any point exceed a thousand miles, in some cases not half a mile. The latter takes place at the bottom of mountains. The thousand miles is at the pole. The other part of the interior of the globe is a cavity, with light equal to that at the pole in December. The extent of the cavity is from one thousand to twenty thousand miles. In this cavity the zinker is placed in a balloon, in which he travels with the speed of electricity: besides this, he has the benefit of the earth's motion when twenty or forty miles below the surface. He perforates whenever he wishes to make observations. A new era has taken place in medicine. The zinkers have already surveyed all the inhabitants of the globe, and, according to their information to me, of the correctness of which I have no doubt, they have improved the breed of the human species. Their work in curing and preventing fever and other diseases affecting the general system is silent, and perhaps almost unknown. Cases, the cure of which would be considered miraculous, are not yet completed, although I understand entered upon. These are cases of blindness, deafness, and lameness. These in all possible varieties have been surveyed, and are all curable, and to be cured, over the whole earth, by means of the zinking mechanicals. When?—I am yours, &c."

Incoherence is an indication of the intellectual disorder in insanity on which I shall not long delay. Suppose that a person of sound mind were to give utterance to his internal thoughts just as they arise, the soliloquy would probably be a very rambling one, but it would not be incoherent. He would be sensible of the relation that regulated their succession, and even an auditor would be able to trace something of the connection of each thought with those that preceded it and those that followed. There would doubtless be certain links that had a disjoined appearance, because every one has certain special ties of association that are peculiar to his individual habits and experience; but on the whole there would be evidently a method in the thinking, and intelligible relations betwixt the several ideas. The incoherence of lunacy is not merely the expression of the vagaries of an unreined imagination. In its highest degree it is a string of ideas that have no relation but that of sequence, a sequence of *non-sequiturs*, so to speak. Incoherence results from all causes that occasion loss of voluntary power over thinking and expression. It may be the temporary consequence of undue emotion, the necessity of influencing delusion, the evidence of impaired memory, or of distracted or enfeebled attention.

Incoherence has sometimes been termed a form of insanity, and the word used as synonymous with a variety of dementia; but though a symptom which is best observed in dementia following mania, it may be a feature in every form of insanity. It is a more usual and more early symptom in the mental disorder of the weak-minded and the uneducated, than in that of the better endowed and better instructed. In mania, whenever the excitement runs high, the ravings of the patient are remarkably unconnected. In such a condition the symptom originates in a distracted state of the attention, occasioned by the delirious course of images through the mind when the associating faculty is deranged. The speech is often seen to be a tissue of half expressed thoughts, the images following each other so rapidly that language cannot overtake them. In dementia, incoherence is the language of an enfeebled and unstable attention. This faculty is the union of perception with desire, but in those who have fallen into the state of chronic dementia the voluntary element in mental action has become so impaired that the faculty of attending is almost lost. Dr. Haslam gives an illustration of this state of the mind in the case of a man who was unable to tell any story straightforward from beginning to end. He would begin with the best intentions, and proceed a little way tolerably well; but the chairs and tables, and all the objects around him, a hat hung upon a peg, or an ornament on the chimney-piece, would become interwoven with his narrative, and lead him from subject to subject. The demented are loquacious about things which have neither sense nor connection, reason nor rhyme. "They speak," says Feuchtersleben, "in the same breath of sabres and toothpicks, children and hats, broken pitchers and dismasted ships." In these cases of partial insanity, so called, in which the patient is said to be insane on one subject or set of subjects, it is common enough to find, especially when the case is of some continuance, that, however collectedly the patient may express himself on other subjects, upon this, his weak point, he cannot give utterance to his thoughts in a coherent strain. The patient is not unsound in mind simply as entertaining a delusion, but still further intellectually disordered that he is also incoherent in reference to his error in judgment. A monomaniac is frequently not merely deluded, but unintelligible: deluded and incoherent on all points connected with his delusion.

Extravagance of conduct.—The intellectual disorder of lunatic patients, besides being manifested in delusion, imbecility of thought, and incoherence, is also seen in their actions, in unaccountable deeds of violence, unnatural impulses, irrational attempts at impossible ends, unfruitful experience, and an insensibility to many forms of discomfort.

Where not merely automatic or instinctive, lunatic actions are the result of the instigation of delusion, though the connection is not always to be made out. Deeds which seem to be incomprehensible may owe their absurdity not to want of premeditation or design, but to insane reasoning in connection with a hidden governing delusion.

An excited maniac spent his time mostly in turning somersets on the ground, which was certainly an absurd and dangerous occupation for a person past his boyhood, and whose business was the grave study of theology. There was no alleged or apparent motive, and little other indication of delusion. I came to understand, from his own information afterwards, that this was done at the instigation of a voice in his head, as being the mode of worship most acceptable to heaven.

Another manifested a strange propensity to climb up the interior of chimneys, to the great danger of his life: in truth, he narrowly escaped suffocation and burning. He was for a time constantly bent on this as the great aim of his existence. It was an action which no one could pretend to understand, unless as a peculiar kind of suicidal inclination, which however it was not. He told me after his recovery that he believed that the only way in which it would be possible to persuade mankind that he was truly the emperor of Russia, as he then supposed himself to be, was by ascending to the roof of the house in that manner. He was a silent lunatic, whose actions were the source of much care and anxiety, and whose delusions could never be surmised.

Professor Alfred Taylor adduces a case which seems usefully illustrative here,—the case of a young man whose insanity led to a criminal deed such as never could have been anticipated from the character of his delusions. "He was a person of mild manners, and laboured under a delusion connected with windmills. He would go any distance to see a windmill, and would sit watching one for days together. His friends removed him to a place where there were no mills, in the hope that this strange propensity would wear away. He enticed a child into a wood, and in attempting to murder it, cut and mangled its limbs with a knife in a horrible manner. How would any sane person," says he, "have connected this delusion with attempted murder? Yet it turned out that he had taken the resolution to commit this horrible crime in the hope that he would be removed as a punishment to some place where there would be a mill."

The violence and destructiveness of which the insane are at times guilty, is often not the evidence of viciousness, but the consequence of disordered reasoning. For example: a maniac, during his paroxysms, amongst other acts of destructiveness, used to occasion much trouble by tearing his shirt and bedding into shreds during the night. After recovery, he accounted for so doing in this way. He said that he was perfectly aware of what he was about, but that he had no idea then that it was anything wrong; on the contrary, he did it more to please others than himself, and actually believed that it was a very meritorious action, which would do some vague kind of good to himself and others, provided he succeeded in tearing the articles into certain determined shapes. He was very much disappointed to find, when visited in the morning, that he was blamed instead of being praised by the attendant; and this he attributed not to having torn his bedding, but to his not having succeeded in making the fragments of the proper shape.

In the published narrative of one who experienced and recovered from a lengthened attack of mental derangement, the same absence of malice is prominently represented. "I knew no malice," he says, "no vice. I imagined that the keepers loved me and were all deeply interested in the salvation of my soul; and I imagined, too, that I loved them deeply. Yet I wrestled with them, and offered to do so with others, and struck many hard blows, sometimes, as one informed me, making it difficult for three men to control me; yet, whenever I did this, I was commanded that they wished me to do so, to prove my faith and courage, but that they were commanded to prove both till they were satisfied of my sincerity." . . . . "It was a great delight to me to get my hand at liberty, even for a moment, and the first use I usually made of it was to strike the keeper who untied me: directed by my spirits to do so, as the return he desired above all things else, because he knew I was proving my gratitude to the Lord Jehovah at the risk of being struck myself."

Thus you will observe many criminal acts might be done by a lunatic without a criminal motive. He might know abstractly that it is wrong to burn or destroy, without being aware that the particular deed of violence which he is committing is any other than good and praiseworthy. We are not likely to trace the motive in the action that an insane person has committed, nor, although he may have set about the action, and carried it out by the very means and in the very way that a sane person might have done, can we infer that he therefore was in a position to distinguish right from wrong.

The acts which a madman performs in obedience to his delusion are frequently not merely unindicative of their motive, but ridiculously unsuitable to the object intended. A patient walking about one of the gardens of an hospital, generally picked up little stones and threw them over the wall, because she understood that the house was by-and-bye to be consumed, and she wished to make her escape. She never attempted to force the door or climb the enclosure, nor did the experience of any preceding day suggest the futility of her persevering in this mode of seeking her object.

General description of the insane state (continued)—(c) Insane impulses—(1) The suicidal impulse—Suicide amongst the insane—its Lunatic characteristics—Medico-legal consideration of suicide—Felo-de-se—legal consequences—Self-murder, insane suicide, and suicidal moral insanity—Circumstances of these contrasted—Suicide from suggestive opportunity, fascination, imitation, &c. When is suicide to be deemed an act of insanity?—Legislation on the subject of suicide—(2) The homicidal impulse—Medico-legal consideration of homicide—Insane homicide and homicidal moral insanity—Reil's description of a paroxysm of mania without delirium—Delirium in agendo—Criminal homicide and insane impulses contrasted—When is homicide to be deemed an act of insanity?—Connected delusion—Contemporaneous delusion—Consecutive delusion—Moral insanity.

The extravagant conduct evidentiary of intellectual disorder, which we have just been considering, does not unfortunately comprehend all the diseased actions that lunatics commit. We have yet to speak of those which do not arise out of delusion solely, but are rather the exponents of the diseased will than of deranged understanding. Insanity is not in every instance want of wisdom merely, but often want of virtue also; it may have the aspect of crime as well as that of folly. When the former predominates, the medico-legal difficulties are great. Lunatics are subject to a variety of *diseased impulses.* This is not merely a medical assumption, but a fact proved by the nature of the actions to which they lead, and the testimony of those who have experienced them. There are no psychological nor physiological grounds for denying that these morbid propensities may be the sole indication of mental disease, and the doctrine is upheld by the testimony of many who have felt its truth, and is admitted by all who have had opportunities of studying the pathology of the mind. When such diseased impulses appear to be uncombined with delirium, they form varieties of what is termed "moral insanity"—that species of insanity (called partial) in which the outward exhibition of the disease is limited to the emotional faculties and the power of self-control.

The suicidal impulse.—The lunatic propensity to self-destruction is the one which we shall first discuss: it is the most common, and certainly not the least curious. The homicidal impulse is only a diseased manifestation of the destructive power, and of the natural inclination to revenge—of tendencies counteracted by moral considerations only; so with kleptomania—so with dipsomania: but self-destruction is a defiance of the strongest instinct of our nature, and, if sanely executed, the extremest assertion of personal freedom.

Amongst the insane, suicide is most frequent in those labouring under monomania with depression, but it may occur as a consequence of any of the forms of insanity. I have known it to be committed by one labouring under extreme and long-standing dementia, in whom there had never been the slightest grounds for suspecting such a desire. In a thousand lunatics, the suicidal inclination was clearly developed in a hundred; and of these, five succeeded in effecting their object. It may be the result of delirium, or false perception, of delusion, of sudden impulse, of insane reasoning, of suggestive opportunity, and of example. It is chiefly to be dreaded in those lunatics who are fond of solitude, and who are the subjects of melancholy, insane terrors and religious delusions.

The suicidal propensity of the insane has morbid features in addition to the disease manifested in the impulse. There are inconsistencies in the modes of its accomplishment. The hypochondriac believes that he is dying of an incurable malady, and is miserable because he is dying; yet he seeks, nevertheless, to terminate his own existence: a monomaniac, fearful of everlasting torments, eagerly seeks to anticipate them with violent hands; another, fearful of the gallows, bends every thought to compass a noose for himself in some unseen corner, apart from those that watch him: and a lunatic who believes that he is already dead, and in the other world, is not by any means to be entrusted with a knife. The delusion of an insane person impels him towards suicide, but often it is suicide in a particular way. He is fascinated, say, by the notion of hanging himself, and requires much care to prevent his design; but, if he is successfully thwarted in this, he may often be trusted with other means of injuring himself. The person who is on such an account compelled to sleep in a bare apartment, whose walls do not exhibit the temptation of a single peg or projection, upon a low bed without posts or curtains, and whose framework is tightly screwed to the floor, may be perhaps allowed with safety to eat his meals with knife and fork, and to enjoy other liberties and comforts which must be denied to others whose suicidal taste is of a different description. In the same way, a lunatic may go on contriving how he shall find an opportunity to cut his throat, to the neglect of all means that may present themselves for hanging himself by the neck. Modes of death are chosen of a kind unknown unless in the history of insane suicide: for example, suicide by starvation is not unfrequent among the insane, but scarcely ever attempted, or if attempted, never persevered in from preference by any person of sound mind. I should perhaps except the case of Pomponius Atticus, the friend of Cicero; but it is not unlikely that his painful disorder had affected his mind: at all events, he was in such a condition as to die on the fifth day, and therefore his perseverance was not brought to an extreme trial. Even amongst prisoners condemned to death, the attempt is uncommon, and success in it almost unknown. Amongst the insane it is otherwise. I have myself known of more than one instance. Sometimes, in obedience to a delusion, it is had recourse to from choice, but more frequently it is the last resource of a lunatic thwarted in other modes of self-destruction. The attempt may be combated in many ways, and is usually overcome; but, if the insane resolution fail not—and the insane will is sometimes unconquerable—a certain and a fearful tragedy has begun. The propensity is treated as a disease, but the subject of it resists physic. Leeches are applied to the head, a blister to the neck—something is done to the epigastrium: he is left alone with food—he is tempted with delicacies—he is encouraged to drink—he is promised all things; but he holds out, and emaciates hourly. Food is introduced into the stomach by a tube passed into the œsophagus by the mouth or nostrils: he resists with all his might; and, if successful, attempts to excite himself to vomiting. He is placed under the influence of chloroform perhaps, but becomes only insensible, not compliant: he is violently fed daily, but is evidently gaining the victory. The struggle becomes dangerous by the exhaustion itself induces. Nourishing enemata are resisted and expelled; and some day, when raised up, he suddenly falls back and dies of syncope. In a well-conducted asylum, starvation is almost the only possible mode of suicide. In those sound of mind it is nearly an impossible kind of self-murder.

Medico-legal consideration of suicide.—Suicide is a crime in law—a fact not of a sort to be of necessity presurmised. It is, it seems, the crime of *felo de se*—a phrase of dubious latinity, understood to indicate self-murder. Of the moral guilt there can be no doubt; but there are many unchristian offences of which legislation makes no account, which it would be more rational to recognise, both for the weight of example, and on the principle of punishing: for those who are bent on self-destruction on any other grounds than a hysterical impulse of imitation, are incapacitated to profit by application of the example, and remove themselves from the influence of human inflictions; the worst is already looked upon and encountered; nothing can harm them more. The goods of a felo-de-se—that is, his own personal and movable property—are forfeited to the Crown, and his will in relation to them is invalid. Formerly the body, having been further mangled by being transfixed with a stake, was buried dishonourably under the highway. Having disgraced his body and robbed his children, the law entitled the wife to her dower, and permitted the real estate to descend to his heirs, or fall to any to whom it was bequeathed. Suicide is not evidence of insanity. The mere fact of a testator making away with his life, although immediately after the execution of his will, is not deemed sufficient ground for setting aside the testament, in so far as the crime of his death permits it to be valid. If an individual commits murder, and thereupon attempts self-destruction, this will in no way affect his legal responsibility. Still further, if an individual in attempting suicide injured another, the mere fact of suicidal intention would afford no plea against trial for homicide. Thus, if a person bent on self-destruction turned a loaded pistol to his head, but from nervous agitation, or some other cause, missed his mark, and shot some one behind him, the suicidal aim would not free him from the charge of blood-guiltiness. One attempting death by drowning has been found liable for the accidental death of an individual who jumped into the water to save him.

We shall distinguish three kinds of suicide—viz., self-murder, insane suicide, and suicidal moral insanity.

Self-murder is that voluntary rational suicide which is implied in the technical phraseology of felo de se. Suicide is not always insanity; it occurs under circumstances which do not indicate incapacitated judgment or diseased will. It may be the sinful result, in an unchristian mind, of a vigorous comparison betwixt long-continued mental distress and transient physical pain, betwixt one mode of violent death and another, between present actual wretchedness and a doubtful condition of future existence. It may be evil done that good may come: thus Leonidas volunteered the required loss of Heracleidan blood at Thermopylæ; Marcus Curtius leaped into the chasm; the citizens of Calais offered themselves for the gallows; and the virgin may prefer suicide to certain dishonour. In some countries suicide has been in certain circumstances a religious duty or customary etiquette. The Japanese dignitary rips up his abdomen when disgraced from office; the concubines of the Peruvian Inca sacrificed themselves on his tomb; and the Hindoo widow immolates herself on the funeral fire. Self-murder is, however, I believe, the rarest form of suicide. It is to be presumed to be a sane act, in the absence of contrary evidence, when such motives as the above are clearly traceable; but even then, when it is the deed of remorse or despair, it the result of a condition as uncontrollable by the judgment as a diseased impulse. Suicide, preceded by revengeful murder, following intelligible motives, implies felo de se. The less painful and the more gradual the mode of death selected, the greater would be the presumption of sanity. Death by poison, charcoal vapour, or chloroform, would less indicate a diseased impulse than would pistolling, cutting the throat, or precipitation. The presumption of insanity would also be weakened by the fact of self-destruction being the result of a community of resolution; as when the member of a suicide club, if such a society exist, is no more to be seen, or the crew of a boarded ship blow themselves and the enemy into the air, or the daughters of a Lord Archibald plunge together into the lake. The conjunct suicide of two individuals only, especially of the opposite sex, may, however, be a conjunction of insanity with a diseased intensity of sympathetic emotion.

Insane suicide is the phenomenon of self-destruction occurring amongst those labouring under any of the forms of insanity, as already spoken of, and on which it is unnecessary to dilate. The deed is to be held as resulting from the mental disease in all cases in which it is committed by a lunatic, whether it can be seen to be attributable to the influence of disordered judgment or not; for we can neither trace all the diseased motives which govern the conduct of the insane, nor, as we have already seen, reconcile their actions with the objects which impelled them. There is no rationale in the doings of lunacy.

Suicidal moral insanity.—The cases of self-destruction which we are to consider as belonging to this class differ from what I have termed self-murder in being associated with symptoms of loss of control, and from insane suicide in being uncombined with manifest disease of the understanding. The suicidal propensity is, in some instances, a form of insanity per se, a variety of moral insanity, and unaccompanied by incapacity of judgment; in other cases it only appears to be so, the intellectual disorder being either undisplayed or overlooked. The simplest example of pure suicidal impulse, uncomplicated with disordered judgment,—suicide from loss of control,—is the self-destruction which may be the result of *fascination*,—the feeling whose approach some of you possibly may have experienced in your own person in looking over a precipitous height. The natural—that is to say, the healthy, impulse in such a position would be an excitement of the instinct of self-preservation; the opposed feeling, though perhaps common, is truly anormal, and has, it is probable, a pathological source, and may be allied to that feeling of vertigo which is still more common in such a situation. This last is said to be a sensation developed only in the special circumstance of an immediate tangible connection with the point towards which the eye is directed: it is felt in looking from a precipice, but not from the car of a balloon: and a similar sensation attends looking up the face of a perpendicular cliff, or to the high roof in the interior of a cathedral, but does not interfere with one gazing on the sky. It would be interesting could it be known whether the suicidal impulse is ever developed by looking downward from a balloon. It may be said generally of suicide from suggestive opportunity, that it is a morbid phenomenon. It is the most producible of all the insane impulses. Were a convenient noose to be hung up in the sleeping apartments of a lunatic asylum, doubtless more than those who went to bed suicidally inclined would be found suspended in the morning. It is not so discreditable to the country that the gallery of the Monument was found necessary to be encaged, as that it was not so protected before that necessity was proved. Suicide from *imitation* is another kind of self-destruction consequent on diseased impulse without deranged intellect, although it has been proved capable of being prevented by disgracing the dead body. The Roman senate finding it necessary on one occasion to attempt the check of a suicidal epidemic amongst the females, succeeded by decreeing the exposure of the suicide's body naked in the public highway; and we are told by Dr. Burrows that the practice of suicide at one time, in a British regiment in Malta, was put a stop to by dragging the naked corpse on a hurdle ignominiously before the whole band, and throwing it into the fosse: but these effects are no proof that the impulse was not a diseased one; true self-murder could not be hindered by such means. The morbid impulse is fettered not by the unaided free will of the individual, but by a strong mental impression tending to arouse the will to free action. Insanity, it has been said, may be prevented or controlled by voluntary exertion; but it will neither be the one nor the other without the agency of external stimulation, unless in the earliest steps of its progress, or the stages of its retrogression. The suicidal inclination is frequently a persistent suggestion rather than a sudden impulse; but is in such cases also a pathological symptom. Our natural instincts, even the strongest, may, in obedience to the higher motives that influence the mind, such as a sense of duty and religious obligation, be successfully resisted; but the annihilation of these instincts, and impulses *contra naturam*, are in every instance to be looked upon as morbid. The desire to terminate life is a psychical reflex of physical disease. "It may be laid down as an indisputable axiom," says one who has thought, written, and seen much of this state (Dr. Winslow), "that in every case of this kind, bodily disease may on a careful examination be detected. We never yet saw a case where a desire to commit suicide was present in which there was not corporeal indisposition." In all the foregoing examples of what we have termed suicidal moral insanity the intellect is understood to be sound; but there are others in which this is at least problematical. In many instances, doubtless, the intellectual complication is concealed or overlooked; in others the deed has been the first and last act of the disordered judgment. The attempt at self-destruction is frequently the antecursor of insanity —the main indication of that premonitory moral disorder to which I have alluded.

When is suicide to be considered as the act of insanity?—In answering this question, you are to keep in view that in the word insanity are comprehended the five varieties of the disorder formerly discussed, one of which, moral insanity, is not yet recognised in law. You are to take into account the history of the individual, the mode in which the action was committed, and the condition of the body. Self-destruction ought to be held as insanity when it is the deed of one hereditarily predisposed to mental disease, or to death by suicide, particularly if the predisposition is inherited from the parent of the same sex, as this gives increased force to congenital tendencies. Dr. Gall, Dr. Burrows, and other writers, have given striking examples of suicide occurring in three or four consecutive generations of a family, the result undoubtedly of inherited qualities, and not to be accounted for on the mere ground of suggestive example and vicious imitation. Self-destruction is to be deemed insanity also in all those cases in which the circumstances of the individual were not such as to develope any of these motives to which allusion was made in speaking of self-murder or felo de se; so likewise in every instance in which it is to be ascribed to mere imitation, or to the fascination of suggestive opportunity. The mode of committing the action may itself be indicative of disease. If little could be inferred from the single fact of a person hanging, drowning, poisoning, or pistolling himself, there could certainly be no doubt of the state of mind of one who chose rather to throw himself into a furnace, to starve himself to death, to crucify himself, or to kill himself by cutting off his genitals. I would also hold it as sufficient ground for a similar conclusion where it appeared, as formerly described, that the individual had not so much the desire of self-destruction as that of dying in a particular way; where, for example, he did not seem to wish to kill himself so much as to hang himself. Suicide amounts to proof of insanity when committed by people labouring under certain diseases: as pellagra,—an endemic skin disease in Lombardy, which, according to Professor Tomassini and other Italian physicians, occasions often an irresistible impulse to self-annihilation,—hypochondriasis, paralysis, hysteria, epilepsy, extreme bodily pain, uterine derangement, spermatorrhœa, nostalgia, intoxication, &c., all of which are efficient causes of mental diseases, and many of them states which are either transitional to, or promonitory of, insanity. Any of those pathological appearances which are more peculiarly connected with mental alienation, if found in the body of a suicide, ought to lead us to the inference that the individual laboured under mental disease; and indeed, in the present state of our knowledge, if we can distinctly make out that he suffered from bad health, the violent death should be ascribed to sympathetic cerebral disturbance. In short, suicide is presumptive of insanity, and ought to be held probative in every case in which the recognised causes of *self-murder* were not clearly present.

Self-murder is the rarest form of suicide; and doubtless many cases of supposed felo de se are examples of obedience to some morbid impulse; all other suicides are probative of unsoundness of mind. Juries have been often twitted with the commonness of the verdict of "temporary insanity" in cases of self-destruction; but they are in the main right in their conduct and dealing with the matter in the spirit that is most philosophical. The practice of the law is, on the other hand, chargeable with being harsh and unenlightened. The attempt "to put down suicide," unless in the way of preventing its causes, is absurd in the extreme, when the deed is not the consequence of epidemic imitation; for the act is an unnatural one beyond legislation. The man bent upon death, whom social affections, conservative instinct, and religious principle do not sway, is beyond the influence of example and authority. He has reached an acme of misery not to be rendered more miserable by the prospect of post-obit vengeance, nor to be deterred from its morbid will by legal consequences often but ill understood, and in a multitude of cases impotent and inconsequential; and he appeals his case to a tribunal higher than all the united states of humanity. Legislation should go no further than this: for the protection of heirs (not their robbery), to vitiate the will of a suicide when it is contrary to the legal order of succession; and for the protection of the public, to hold the intention of suicide, when accidently productive of death to others, to be punishable as homicide, unless where insanity can be clearly established, in which case the individual should be confined for life.

The homicidal impulse.—The manifestation of this propensity is much more rare among the insane than the suicidal impulse is. The desire to kill was a feature more or less abiding in about 1 per cent. of the cases treated in the Aberdeen Lunatic Asylum. The insane may commit homicide under the influence of delusion, delirium, imbecility, where there is imperfect appreciation of consequences, or simply as a result of the moral perversion which accompanies the disease. The propensity is rather more common in the insanity of females than of males; it is most usually combined with epileptic mania.

Homicidal moral insanity may be employed as the term to designate those cases in which a morbid impulse to kill is the sole indication of diseased mind. Though much less common, this is a form of mental disorder as veritable as the suicidal moral insanity of which we have spoken; it is admitted by all recent writers, and has been recognised in criminal courts. The propensity has been found combined with the conditions of menstruation, pregnancy, parturition, uterine derangement, gastric disorder, cerebral congestion, epilepsy, and hypertrophy of the heart, and may be persistent, intermittent, or occasional. These conditions are to be looked upon as predisposing physical causes; there may be also predisposing moral causes at work,—as, for example, grief and despondency; but the deed flows immediately from some mental impression by a morbid action so powerfully exciting the homicidal idea, as to give it an instinctive force, leading to an action which is irresistible,—independent of the will. The deed may be the result of imitation, the idea induced by murderous narratives, or suggested by the sight of lethal weapons, or by the exposed and defenceless condition of the victim. When the psycho-physical relation is once disturbed, whether by the influence of corporeal or of mental agencies depressing the vitality, and the predisposition to diseased manifestations thus induced, ordinary influences become exciting causes of extraordinary conduct. I have already said that mental impressions, often of a common kind, are the originators of delusion (incapacitated judgment); so are they also of irresistible impulses (incapacitated will). In the former case, extravagant conduct results mediately from the delusion excited; in the latter, it results immediately from the mental impression, which, being an emotional one, manifests itself in action without any intervention of intellectual disorder. The homicidal impulses, and the insane impulses in geneal, constitute, therefore, the simplest and most completely objective form of madness. Reil adopts the same view. He considers them to be forms of mania, and to be mania without any extraneous addition. He appears, in the following description of the paroxysm, to assimilate its phenomena to those of epilepsy. "The paroxysm," says he (I read from Feuchtersleben's Psychology), "generally begins with all kinds of corporeal phenomena: a pressure exists at the pit of the stomach; shuddering through the whole body (often commencing at the spine); the tongue is loaded; there is a sensation of burning heat in the bowels; great thirst and constipation; the heat rises upwards to the chest, neck and head; this last aches; there is a singing and buzzing in the ears; the look becomes anxious; the patient says that the heat rises before his eyes; he often warns those about him, and entreats to be prevented from doing mischief; the countenance becomes flushed; the arteries of the neck and temples throb violently: at length the excitement extends to the brain; and at this moment arises the blind irresistible impulse to murder, commit suicide, theft, arson, or some other outrageous act; just as epilepsy ensues when its preliminary *aura* has reached the brain. These somatic (corporeal) symptoms are, however, often wanting. The disease is permanent, though mostly periodical."[*]

In homicidal moral insanity there is no discoverable intellectual disorder antecedent or subsequent to the act. Several writers maintain, however, that there is disordered perception or delirium during the time that the deed is done. In such a paroxysm as that vividly described by Reil, one would infer delirium in the climax. Without insisting on this feature in every case, I believe that very frequently the patient may not have a competent knowledge of circumstances at the time.

I shall not take up your time quoting examples of this variety of insanity, leaving it to yourselves to study the many cases which you will find recorded in medico-legal works. I have often seen the homicidal desire as a feature of derangement, but have met with only one or two instances, and these not of a striking kind, in which the impulse itself formed the sole mental disease. In one of these cases the subject was a young woman, of a good and cheerful disposition naturally, who acted as a servant to an invalid lady. Her health got disordered from the nature of the duties which she had to discharge. She lived in the most solitary way, was very rarely indeed out of doors, and had to submit to perpetual night watching, and the constant peevishness and selfish exactions of an invalid. Such were the predisposing causes of the malady. The propensity was engendered by reading to her mistress, night after night, from newspapers, details of those monstrosities of crime which are so usually to be found in their columns. She was at length seized with a morbid desire to strangle her mistress as she lay asleep. The impulse grew stronger and stronger, and feeling that it would become irresistible, she determined to save herself by flight. She left her situation, and, at her earnest solicitation, to be protected from the consequences of her actions, was lodged in an asylum. This patient had not the melancholic temperament which is common in such cases, had no hysterical tendencies, but was robust, of a sanguine habit, cheerful, and well inclined. There was no disorder in the uterine functions; the only distinct symptoms of disease were gastric, accompanied with headache and restlessness at night. When removed to the hospital there was no manifestation of mental affection, save depression of spirits; and when her disordered health was rectified she was discharged, and has ever since kept well.

Homicide from insane impulse differs from murder, in being a diseased act, suddenly committed in blind obedience to an instinctive impulse, or to a desire which has gradually become irresistible. None of the ordinary motives of crime are discoverable: there was no antecedent enmity or quarrel, and there is no resulting advantage. The objects sacrificed are most likely either previously unknown to the patient and accidentally encountered, or they are those, as his wife and children, whom he has always regarded with the deepest affection. The act is one indicative of much mental and physical excitement; it is not slow-poisoning secretly carried out, but a bloody deed savagely done; there is probably not one wound, but many; not one ghastly corpse, but several. When the slaughter has satiated the desire, there is either terror and flight, grief and confession, or remorse and suicide; but as frequently no relief seems to follow the indulged impulse; in which case there is neither attempted concealment, surrender to justice, denial, nor remorse. There will often be evident physical disease, with indications of moral insanity, or perhaps even of approaching or overlooked intellectual disorder. None of the circumstances of the action necessarily indicate insanity; the most characteristic of them are of occasional occurrence in criminal homicide. The absence of all motive is presumptive, but is with difficulty distinguished from concealment of motive; and the dependence of the impulse on disease, with its independence of the will, may be indicated in the history of the homicide and his crime, but cannot be indubitably proved.

When ought homicide to be considered as the act of insanity?—In speaking of self-destruction, I stated that the act by itself is to be held as presumptive of insanity; but in regard to homicide the presumption is much more on the side of crime than of disease; the former runs contrary to natural instincts, whereas the latter results from normal impulses which the divine commandment indicates have to be restrained. Every one has the capacity to kill in self-defence; but there are many whom the instinct of self-preservation would, in all circumstances, keep from self-destruction. Homicide is not to be held as a criminal action when it is committed by one labouring under any form of delirium, the consequence of disease, or naturally of such an imbecile condition as to have an imperfect knowledge of right and wrong, and an imperfect appreciation of consequences. It ought to be considered as an act of insanity when it flows directly from a delusion which overrides the judgment and directs the conduct; indeed, in every case in which insane delusions exist, the presumption is strong that the deed is an act of insanity, whether it can be directly traced to the impulse of delusion or not; for, as already insisted upon, the consequences of a delusion are not to be foreseen. When outrageous or extravagant conduct co-exists with delusion, they are probably connected with each other, although the relation may not be apparent. Homicide, without any of the usual motives of murder, ought to be esteemed an act of insanity when it is followed by evident derangement of mind; for the deed has, in such a case, it is to be presumed, been the consequence of the moral perversion, which you are aware is so often the initial symptom of lunacy. In cases in which no intellectual derangement is obvious, the action is still to be attributed to insanity when it appears to have been motiveless, the manifestation of a blind irresistible impulse, inconsistent with the natural tendencies of the individual, and indicating in its circumstances the temporary existence of delirious loss of control; when it is also the act of an individual labouring under some of those diseased states which are frequently associated with insanity, as cause, complication, or consequence,—who has a hereditary predisposition to disease of the mind, or who has at some former period actually been afflicted with the malady.

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[*] In a case of insane impulse (suicidal and homicidal) which I lately saw with Dr. Christie, of Aberdeen, the existence of our *aura* as described by Reil was well marked. The strange feeling, described by the patient as a "heat," began in the lower extremities, progressing gradually upwards to the head. The impulse was not manifested merely when the paroxysm reached its height, but commenced at the same time with the aura, which produced an intense feeling of restlessness and wretchedness when at its climax.

General description of the insane state (concluded)—(c) Insane impulses (concluded)—(3) The impulse to steal—a symptom in insanity—sometimes a form of insanity—Kleptomania—distinguished from criminal theft—(4) The impulse to burn—sometimes a form of diseased mind—Pyromania—its characteristics—(5) The impulse to intoxication—medico-legal consideration of drunkenness—legal relations of drunkenness—modifications in practice—the propensity to intoxication sometimes a disease—Dipsomania—legislation on the subject of drunkenness—(6) Morbid sexual impulse — Cytheromania — (7) Unnatural impulses—(d) Physical condition of lunatics—physiognomy of the insane—the insane expression—the eye—the mouth—the ear—the complexion—the bodily physiognomy—automatic movements, &c.—odour—muscular power and endurance—insensibility to discomfort—pulse—Post-mortem appearances—Feigned insanity.

ANOTHER impulse originating from disease, which is of frequent occurrence among the insane, is the *impulse to steal.* I have frequently known it to be one of the earliest symptoms of insanity.

A medical student, a quiet orderly fellow, suddenly took to drinking porter and stealing books, making no particular attempt to conceal either the one propensity or the other, but just as he was becoming an object of interest to the fiscal, a paroxysm of mania broke forth in full force, and the lunatic asylum was made his prison. Unmeaning theft is a common enough symptom in mania.

A poor country labourer, much deformed in his person by rheumatism and hard labour in peat mosses, and of a reserved and dispirited cast of disposition, became afflicted with mania, in which was manifested neither delusion nor incoherence; indeed, there could be said to be no indications of intellectual disorder unless a more rapid flow of ideas than was natural to him; the sole symptoms, in addition to physical disturbance, were unnatural cheerfulness, excessive talkativeness, Munchausen-like lies, and a most remarkable propensity to thieve. It did not matter what he came across; if it was small, it was pocketed; if it was eatable, it was swallowed. When he washed himself in the morning, he generally managed to finish the operation by pocketing the soap and hiding the towel. If a patient fell asleep in the airing yard or at the fireside, he was on the watch for an opportunity to plunder him. If a pair of stockings was amissing he was sure to be found with two pairs on his legs.

The propensity to steal sometimes occurs as a disease uncombined with intellectual derangement, or with unnatural excitement, as in the above case; it then forms a variety of moral insanity, and has been written of under the name of *kleptomania*. Some have sneered at this disease, but the fact of its being at times a premonitory indication and a phenomenon in maniacal delirium, forms an argument for its probable occurrence as a morbid impulse. The propensity to acquire being a natural one, constantly stimulated by the temptation of opportunity, controllable and requiring to be controlled, and the punishment of theft not being like that of homicide, extreme and irremediable, the proof of disease ought to be very clear before such a plea is allowed to have weight. Kleptomania may be presumed when the theft is the act of an individual not of a vicious character, not impelled apparently by the ordinary motives of the crime, who has hereditary predisposition to mental disease, who has formerly been insane, whose natural disposition has suddenly or gradually become changed by fever, nervous disease, injuries of the head, and by such conditions as pregnancy, or disordered menstruation, or who manifests other traces of disordered mind immediately subsequent to the act. The circumstances of the theft must also be taken into account along with the character and history of the offender. The impulse should be motiveless and irresistible. The plea will be strengthened if the articles are heterogeneous, of less trifling value than there was opportunity to seize, appropriated without ingenuity or attempted concealment, unsuited to the wants, the condition, the tastes, the sex, of the individual, not sought to be turned to any account, unheeded after they are possessed, and not missed when returned to their owners. Lavater tells of a physician with this affection, who daily robbed his patients of such articles as spoons, scissors, keys, and work-table gear; he never made any use of these things, nor seemed to miss them, though they were daily returned by his wife. A craze may be apparent in the nature of the articles collected: for example, an agent of the government at Vienna, we are informed by Dr. Gall, had a mania for kitchen utensils; he stole nothing else but only pots and pans, which he stowed away in a couple of rooms hired to hold the collection, and there they remained unused and unsold. I have heard of kleptomaniacs, but have never met with any in whom the mental faculties were not clearly deranged.

The next diseased impulse to which it is necessary to allude, is the *incendiary impulse.* The propensity to burn is not amongst lunatics a mischievous bent remarkably more common than other forms of destructiveness, and would not require special attention, were it not that there are grounds for believing that such an impulse may be a result of mental disease, when there is no evidence of disturbed understanding. I have occasionally known incendiary acts to be performed by the insane; the nearest approach to simple morbid impulse was in the case of a supposed criminal, in whom the fire-raising, which led to the apprehension of the individual, proved to be a forewarning of insanity. The incendiary impulse, as a variety of moral insanity, is usually termed *pyromania*, and is a disease recognized by all the best authorities in medical psychology. According to Esquirol, there are facts sufficient to prove, that certain incendiaries are moved by an instinctive impulse independent of their will, the burning being the result not of delirium, delusion, nor want of reason, but yet of a diseased motive which may be incontrollable. A German authority, of the name of Henke, was struck with the frequency of incendiarism by young individuals, and propounded the view, that fire-raising is in many cases to be attributed to the condition of the system at puberty, and is a disease related to the mental disorders and convulsive affections which sometimes make their appearance with the sexual development, more particularly in females. The propensity has been observed in connection with amenorrhœa, imperfect sexual character, natural imbecility of mind, epilepsy, and other nervous disorders allied to insanity. The plea of pyromania has been admitted by juries in this and other countries. For examples, I refer you to the later writers on insanity and forensic medicine. In such cases the act is motiveless, probably repeated without caution or self-protection, on various dissimilar occasions, by an individual about the age of puberty, who has a known tendency to mental disease, who is subject to some convulsive disorder, or who in most cases is of the female sex, and labours under some disease or disturbance of function in the sexual system.

The *impulse to intoxication* is often a very prominent feature in the moral disease of lunatics. Drunkenness may be a cause, a forewarning, a complication, or a consequence, of diseased mind. Insanity is a disorder in which there is an unusual craving for stimulants of all kinds.

Medico-legal consideration of drunkenness.—The state of intoxication is not an exculpatory plea in law, nor does it constitute such a state of unsoundness of mind as to invalidate civil acts. Though it must be admitted to signify a condition in which emotion is perverted, and reason and judgment not sanely exercised, still, as it is a form of unsoundness voluntarily induced, the individual is held to be responsible for actions committed. A habit of drunkenness does not afford legal grounds for placing a person under restraint or confinement, or for interdicting him from the management of his own affairs. In Scotland, one who from habitual intoxication is liable to be imposed upon and taken advantage of, may, if he choose, inhibit himself, as it is called,—that is to say, he may put himself under trustees or curators, without whose sanction no act of his shall be valid. Any confession which an accused person may unguardedly make when in a state of intoxication may be used as evidence against himself or others, having no less weight than the voluntary disclosures which he may proffer in sober moments. No one is called upon to criminate himself; but voluntary statements, whether sober or drunken, though they may be afterwards denied, cannot be nullified as evidence by any retraction. Such is the general statement of the law; but there appear to be occasional modifications in practice. A distinction is made between partial and complete drunkenness; neither is understood to afford an exculpatory plea for criminal actions, though the latter might be with propriety urged in mitigation of punishment. Extreme intoxication, such as interferes with personal consciousness, has been held to vitiate civil acts; and, no doubt, lesser degrees would be similarly protected if the unexpected result of some accidental and unknown physical condition rendered the individual unusually sensitive to the influence of stimulants; so, also, if the state were apparent to all, and brought about by the contrivance and collusion of evil-intended parties for the special purpose of obtaining an advantage. As the law estimates the degree of culpability more from the intent than the effect of an action, it may often be of importance to plead the state of drunkenness as lessening the presumption of malice.

The propensity to drunkenness as a morbid impulse may manifest itself independent of intellectual disorder; in such a case it constitutes the variety of moral insanity usually referred to under the name of *dipsomania.* The possibility of drunkenness being at times itself a disease, seems indicated by several circumstances. There are pathological relations between intoxication and insanity; the former sometimes passes into the latter, and more frequently still forms a predisposing or exciting cause of mental disease; the latter often unexpectedly developes the propensity to the former; a state of dipsomania suddenly appearing is not unfrequently a leading symptom in the premonitory stage of insanity. Drunkenness is often a consequence of physical organization,—an original sin of the constitution, hereditary, and partaking of the ordinary characters of hereditary disease. It is also sometimes a periodical disorder, and in all respects incompatible with the habits of the unfortunate sufferer during the intervals. Habitual drunkenness has been known to have been induced by alterations of disposition following diseases and accidental injuries of the head. Cerebral irritation from continued or intense mental emotions also occasionally compels to it. The following, with other similar cases, is narrated by Dr. Ray:—A young man, a sailor, was, for his sobriety and good conduct, elevated to the command of a ship; "but," says the writer, "no sooner did he reach this reward of his merits, than he began to drink with all the recklessness of an old toper. As soon as he was degraded to an inferior station, no man could be more temperate; and this appearance of reform each time encouraging his friends with the hope that he had abandoned his bad habits altogether, they would restore him to the station he had lost, to be again and again forfeited by his mad propensity."

The propensity to intoxication, when dipsomaniacal, does not follow temptation or opportunity, is contrary to habit, hereditary, conjoined with predisposition to insanity, follows some special, mental, or physical cause, is sudden, or connected with antecedent change of disposition and character, irresistible, periodical, and solitarily indulged during a lengthened unremittent paroxysm.

Enactments on this subject have varied much in different countries and times. Sometimes drunkenness has been entirely overlooked by legislators; in some cases it has been admitted as a plea in extenuation of crime: it has been punished by fines, imprisonments, and loss of civil status, and even, under special circumstances, by death. At present, in this country, it does not appear to be sufficiently recognized either as a crime or as a disease. Legislation on the matter would be, no doubt, difficult, but not more difficult than important and useful. It would be well for society that the habitual drunkard should, in many cases, be interdicted from the control of his affairs; and it would very much lessen the labours of justiciary lords, were dipsomaniacs allowed to be put under control and restraint, subject to every inspection desirable for the prevention of abuse. Such individuals should be placed beyond the power of falling into criminal acts, or be made liable only to a mitigated punishment for crimes which legislation is careless to prevent.

Disease of the sexual impulse is not uncommon amongst the insane. It may occur as a form of moral insanity, and give rise to medico-legal difficulties. Under this head would be included the nymphomania and satyriasis of nosologists: these and such like might be comprehended, for uniformity's sake, under some such term as *cytheromania;* reserving the term erotomania, which has sometimes been made use of, to represent that species of monomania or of moral insanity in which the sentiment of love is insane.

Lastly might be specified unnatural impulses, which are occasionally combined with insanity of intellect. It is probable that even where this is not the case they may be attributed to disease as often as to brutality. In the words of Dr. Prichard, "they have given rise to a series of phenomena in human actions which have been considered to belong to the province of the moralist, or the enacter of penal chastisement, rather than to that of the medical philosopher. That this opinion has been founded in error," says he, "we are fully convinced; and we doubt not that the time will come when the very names of many offences against decorum now considered as punishable crimes will be erased from the statute-book, and when persons now liable to be sentenced to the pillory or the gallows will be treated as lunatics."

The physical condition of lunatics.—In continuation of the picture of the insane state, and in conclusion of it, I shall now advert to the physical condition of lunatics, directing your attention first to the peculiarities of the lunatic countenance.

The physiognomy of the insane.—Well established facial characteristics of disease are of great diagnostic value, affording pathognomonic indications which no endeavour of the patient can conceal, and which enable those who have profitably studied the expression of disease to come to a fixed and correct conclusion upon a slight examination in instances where one less skilled might, after more laborious proceedings, continue in a state of uncertainty. Physiognomy as a science of character is a most vague and fanciful affair. It assumes, however, a more practical value in states of sickness, in which we do not look on the countenance as an index of disposition, but as an exponent of accidental and morbid psycho-physical sympathies. Expressions of disease, though less instinctively understood, are, when once known, more to be trusted in than expressions of thought or emotion; and when these last are not natural, but morbid, they are, being more involuntary, less calculated to mislead. The knowledge to be acquired from the appearance of the countenance is of greatest value in those temperaments in which there is most reaction between the mind and the body, and in those diseases which are most likely to induce mental anxiety and distress, or to occasion actual sympathetic disorder of the mind. "The study of the physiognomy is more essential in mental derangement," according to Dr. Burrows, "than in almost any disease. It not only guides us in doubtful cases, and instructs us to ascertain a hereditary predisposition to insanity, but also warns us of its approach." It may enable the medical jurist to come to a ready determination in cases of simulated insanity, to distinguish the approach of the disease, the presence of a lucid interval, and the validity of recovery.

What is the peculiarity in the expression of insanity? Painters and others have represented it either as simple exaggeration of emotion, or a jumble of incompatible characters. Sir Charles Bell conceives that it is a brutalized type of expression. Sir Alexander Morison, who has given much attention to the movable physiognomy of the insane, seems to think that it is a combination of wildness, abstraction, or vacancy, with the ordinary expression of the predominating emotion. I believe that Sir Charles Bell's opinion is a correct statement; the expression of insanity is always degraded and repulsive. I refer you to the drawings and casts before you. How inferior is this excited aspect to any natural expression of mirth, self-confidence, or excited expectation! How different this suspicious look of ferocity from the coarsest natural expression of anger! Here is a monomania of pride;—distortion, not dignity, not even a ludicrous, but only an ugly caricature;—here the monomania of fear—the aspect and action of a terrified cur.

The *eye* is in mania an unnaturally brilliant, quick, unsettled, and projecting eye, with usually a contracted pupil. Here is what writers term the "occulus bovinus"—a wide, dilated, and prominent orb, with an exposure of the whole circle of the iris. In melancholy the organ is dull, slow, downcast, and evasive. In dementia it has lost much of its natural brilliancy of expression; the pupil is dilated, the eyes droop, and the supercilia are drawn up on a low wrinkled brow, giving an appearance of stupid amazement. In cases where intemperance has been at work producing the disease, the eyes wear all along the intoxicated expression.

Many characteristic traits are to be observed about the expression of the *mouth*, especially in dementia and imbecility. It would be difficult to convey an accurate idea of them in verbal description: you will remark them in the examples before you. There is a peculiar relaxed expression very characteristic of primary or acute dementia, which contrasts very remarkably with the natural expression of the countenance as represented after recovery.

It is a curious fact, that there is a certain conformation of the external *ear* which is occasionally to be observed amongst the insane. To this my attention was first directed in the Hanwell Asylum by Dr. Conolly; but I believe the observation was originally made by M. Foville, who has also in addition remarked, I understand, some relations between the configuration of certain portions of the organ and the condition of the brain. These may be fanciful; but true it is that changes do take place in the shape of the ear, especially in cases of old standing: the lower portions of the pinna become enlarged, misshapen, and more vascular, while the helix and antehelix seem flattened and defective. These changes would point out some as yet but indifferently understood relationship between the condition of the cerebrum and external ear, which there are some facts to confirm: for instance, we are told by Kirby, in his "Habits and Instincts of Animals," that in the horse the condition of the ear in a certain particular varies with the wildness or tameness of the animal,—with its state of cerebral education in short.* In the wild horse the ears lie back; in the domestic or cultivated one they are erect. Every representation of the trained animal, however ancient, as on Grecian and Egyptian sculptures, exhibits it with the ears erect; whereas in the wild horses of Tartary, and those which have run wild on the mountain plains of South America, they are uniformly recumbent.

Finally, as regards the facial appearance of the insane, you will find that in very few instances indeed is the *complexion* of a lunatic unexceptionable In mania, when the disease is recent, the countenance will sometimes bear the appearance of health; but in all other forms of non-congenital mental derangement, and wherever the disorder is of any standing, the skin has either a pale and leuco-phlegmatic hue, or it is sallow, dirty, and badly coloured. A clear condition of the skin you will very seldom observe amongst lunatics. Beauty is what you will fail to discover in a lunatic hospital: the physiognomies are lined by the expression of diseased feelings, which expression is seldom such as to inspire sympathy, and never admiration; the trace of every benevolent emotion is too frequently banished from the countenance, giving place to cunning, suspicion, timidity, outrageous passions, and unworthy propensities.

The *bodily physiognomy* of lunatics, or their carriage, attitude, and gait, is also characteristic, as you will see from some of the graphic representations before you. On this point I shall no farther dilate than to say that the maniac may show, during paroxysms of excitement, more than his natural degree of grace in his frantic movements; the melancholic has an external appearance of slowness, shrinking, and oppression; the monomaniac with a high delusion expresses his ruling passion in a caricature of its natural language; and the positions of the imbecile and demented are usually degraded and debased.

The incurable class of the insane often exhibit a variety of *automatic movements*,—that is to say, certain habitual involuntary or semi-involuntary actions of an unvaried monotonous kind, such as an automaton might be contrived to perform. Such a symptom does not, however, of necessity indicate an incurable form of disease. These convulsive and habitual movements have received the name of *tic* from the French writers on insanity. It would be futile to attempt enumerating them, they are so various. I may mention here a curious action confined to paralytic lunatics—namely, a grinding movement of the teeth against each other, productive of a sound much louder than any you would conceive could be produced in this way. The sound is very loud, and in a room where two or three such patients are congregated together I have heard it absolutely amount to a distressing noise. It is a curious symptom, but speedily put a stop to by death. There is another phenomenon still more singular, occasionally manifested by incurable lunatics, and that is rumination—a symptom which has sometimes, however, been known in dyspeptics not insane.

Insanity is frequently accompanied with a peculiar odour of the perspiration and the breath. This fact looks odd, but many other conditions have a concomitant and peculiar effluvium. There is a peculiar smell which often precedes death, and which is an absolute indication of its approach—a sort of earthy odour prophetic of the churchyard. Gout and rheumatism have also a peculiar odour; and the disease called the pellagra—a combination of a mental and a skin disease which occurs in Italy—is said to be distinguished by a smell like mouldy bread. The smell of mania is described as being quite sui generis. In some books you will find it compared to the odour of [illegible] in a state of fermentation. It is not confined to any of the particular forms of mental derangement. "The maniacal odour," says Dr. Burrows, "is not always present; but I consider it a pathognomonic symptom so unerring, that if I detected it in any person I should not hesitate to pronounce him insane, even though I had no other proof of it." Such an opinion from an authority so respectable makes this occasional symptom of mental disorder deserving of notice. A person affected in this way will almost always be offended by the breath of insane patients. All are agreed as to the insane being liable to be the subjects of a very powerful and disagreeable odour, whether special or accidental. It is remarked by all attendants, and who have to deal with the repairing and washing of their bedding and clothes. In an old, ill-constructed and badly ventilated asylum, I was once witness to two female attendants having their stomachs fairly upset by it in the morning, as they were engaged in unlocking the doors and opening the shutters of a gallery of sleeping apartments.

Mental alienation is a disorder related to physical debility; yet, during paroxysms of excitement, lunatics often manifest wonderful *muscular power and endurance*. Young and delicate individuals will perform almost incredible feats of strength, and continue for days in a state of incessant motion and exertion of voice and limb, with perhaps little or no sustenance, continued want of sleep, and in spite of all the means which may be employed to depress their strength and calm the violence of their excitement. It is only, however, during a period of maniacal exaltation that the insane manifest an increase of muscular power; they are ordinarily of less than average vigour. Such an appearance of strength is in a considerable degree fallacious, being in part attributable to diminished or perverted corporeal sensibility. Indeed, when the bodily organs themselves make it clear that they have been exerted far beyond the legitimate extent, the maddened brain will still impel them to obey its destructive mandates. You will see maniacal patients, after they have from unceasing vociferation shouted themselves into a state of inarticulate aphonia, persevering in their vocal attempts till at length they are prevented by fatal exhaustion. Epileptic lunatics have generally an augmented degree of strength during their periods of excitement. Demented patients, unless when epileptic, are usually feeble in body. When melancholics and monomaniacs exhibit much strength and endurance, the exhibition of it is attributable to blunted sensibility. In such a case they may be capable of undergoing great fatigue in obedience to their delusions; but when the will is exerted in a healthy way, in furtherance of any other object, they exhibit not merely a small capacity of attention, but a slight power of exertion and endurance.

The insane frequently manifest much insensibility to external impression, and much endurance of want of sleep, cold, hunger, and discomfort. This is an evidence of anæsthesia, not of strength or robustness. They may actually suffer physically, though they do not express themselves as sensible of suffering; the condition of insane abstraction from surrounding circumstances, and the absorption of attention by delusion, serving to deaden all natural impressions. A knowledge of such particulars is of importance for the discrimination of feigned insanity.

Dr. Rush, we are told, decided upon the insanity of a criminal from the single fact of an excited pulse. Now, as regards the pulse, it is not much to be trusted in determining mental disease. In the insane it may be found varying from 60 to 120. The most common pulse in lunatics is one which is not at all indicative of any state like acute inflammatory action; it is a soft and indistinct pulse, between 80 and 90, and easily quickened.

There are certain peculiarities in the constitution of the blood, urine, and secretions, which possess no little interest, but which we must pass over, as they would lead to a discussion upon the pathology of the disease beyond our province. I shall just briefly enumerate certain of the postmortem appearances that are frequently found in the bodies of lunatics. These are, altered thickness of the scalp and calvarium; opacity, thickening, and adhesion of the meninges; effusion of serum into the subarachnoid tissue, the sac of the arachnoid, and the cavities of the ventricles; atrophy of the cerebral convolutions; redness or atrophy and increased density of the vesicular nervous matter; disease of the heart, particularly hypertrophy of the left ventricle; disease of the lungs, particularly phthisis; disease of the abdominal viscera, and, as a peculiarity, displacement of the colon. No definite relation has been established between these or other morbid changes and special forms of mental disease. They do not constitute the disease, but are allied with it, sometimes as causes, sometimes as consequences, and sometimes as mere accidental complications. The last appearace alluded to is most common in cases of melancholia, and was first taken notice of by Esquirol. He observed that the colon, instead of pursuing its transverse course from the right to the left side of the abdominal cavity, was sometimes suddenly precipitated and tied down behind the pubis, or deflected from its course at the transverse portion in the form of an inverted arch of greater or less extent, at one time being a slight curve, at others a loop so long as to fall into the pelvis. Most of these post-mortem appearances are best marked in old cases. It often happens in recent cases, and occasionally, too, in old cases, that no pathological alterations whatever in the brain can be discovered either by the knife or the microscope. There is no mode of investigating insanity so discouraging as that by post-mortem examinations, and few have persevered very long in the attempt to elucidate its mysteries in this way.

You have now had laid before you a description of all the features which are characteristic of the insane condition—at least, all with which it appears necessary that the medical jurist need be acquainted in order to expose feigned insanity, and to give sound opinions in cases of judicial difficulty.

On the subject of *feigned insanity* I think I may venture to be very brief. I need not lay before you the objects which may lead persons to feign madness: but bear in mind that a person may be suddenly attacked with insanity under some of the ordinary circumstances which tempt persons to feign the disease. For example, the excitement accompanying the commission of a criminal deed, the remorse which may follow its execution, or the shame of discovery, might occasion a real attack of madness liable to be canvassed and dealt with as a feigned lunacy, owing to the suspicious circumstances in which it had been developed. All forms of insanity are difficult to be feigned, and easy to be detected when attempted to be simulated. The general rules for the detection of feigned disease are applicable to the detection of insanity. I need not take up your time describing how the imposition of imbecility, maniacal excitement, fixed delusion, or morbid impulse, is to be exposed. The history of the individual, his character, the history of his crime, the aspect of his symptoms, are all available. Every circumstance mentioned in describing the lunatic condition has a practical application to the discrimination of feigned insanity. The true lunatic has peculiarities of physiognomy, attitude, action, and appearance: he has certain distinguishable and broadly marked emotional and intellectual symptoms, which would require to be long and perseveringly studied to be successfully imitated by even the most accomplished actor, and there are pathological features of madness which cannot be assumed. I do not think that there are many diseases whose subjective symptoms it would be more difficult to feign. In most instances, a feigned lunacy would be at once suspected, even by the inexperienced, and in every instance distinguished by those well acquainted with the characteristics of the disorder. Those who do not know insanity from having personally observed it seem to conceive it badly. Dramatists and writers of fiction, excellent depictors of natural character, have not in general been very successful in their delineations of insanity.

When is mental aberration such as to justify its being deemed insanity? Discrimination of acute and maniacal delirium—Directions for the examination of the Insane—special difficulties—Lunacy certificates—Scottish Lunacy Law, Asylums, and form of certificate—Proceedings under the English Lunacy Act—form of certificate—When is mental unsoundness such as to justify interdiction? interdiction defined—Scottish and English mode of procedure—grounds of interdiction—Testamentary capacity of the Insane.

You have now in the course we have followed seen the condition called Insanity compared with the similar and allied states which most resemble it; we have reviewed the legal doctrines and practice in regard to it—its nosological divisions with their leading characteristics; we have glanced at some particulars in its statistics, and dwelt at length on the physical, emotional, intellectual, and impulsive features of the disease, embracing with various other matters of forensic application, the medico-legal specialities of suicide, homicide, theft, fire-raising, drunkenness, and feigned insanity; let me request your attention farther to the discussion of certain judicial questions connected with the subject, and to various matters that are best considered in relation to these.

When is mental aberration such as to justify its being deemed insanity?—Although it may have an essential character, insanity is not one uniform manifestation of psychical or physical inefficiency. Sometimes it is intellectual defect (imbecility, amentia,) sometimes intellectual disorder (delirium, mania,) sometimes destruction or loss of faculties (dementia,) sometimes permanent but particular incapacity of judgment (delusion—monomania,) and lastly, it may be merely diseased passion and loss of control (moral insanity.) It has therefore to be distinguished from intellectual dullness and ignorance, from febrile and temporary sympathetic delirium, from illusion and hallucination, from eccentricity and depravity. It is often associated with physical disorders, and on this ground bears a resemblance to all diseases which have sympathetic mental disturbance combined with them, some of which, as for example hysteria and hypochondriasis, are transitional to insanity, and not very readily to be distinguished from it. Intellectual deficiency is not insanity, unless it be the consequence of congenital defect of the faculties natural to humanity (amentia,) or destruction of them by cerebral disease (dementia;) the individual must through his whole life have been under the mental capacity of his fellows, or display deficiencies which are unnatural to his former self. Excitement, delirium, incoherence, are insanity (mania—dementia) only when persistent, associated with delusion, and concurrent with physical disorder. Illusion and hallucination indicate the insane condition (mania—monomania,) when they cannot, as formerly described, be made subservient to the operation of comparison, when they defy the judgment, and govern the conduct despite of reason and free will. Exalted passion, erratic propensities, and tyrannous impulses, cannot be deemed mental disease (moral insanity,) unless they be foreign to the character of humanity, or to the natural disposition of the individual, and the apparent consequences of diseased incapacity of self-control. I shall not recapitulate, however, what I have already said of these matters, but restrict myself to the marks which distinguish acute from maniacal delirium. I have repeatedly known the latter to be mistaken for the former.

In febrile delirium the ravings of the patient are less rapid, less intelligible, less distinctly enunciated, and less related to surrounding circumstances. The mental symptoms have not been the first to attract attention, and they are not the most urgent; there is serious bodily disorder, great disturbance of the circulation, a high temperature, evidence of uneasiness and pain,—probably tremor, feebleness of body, and loss of appetite,—symptoms very unusual in maniacal delirium, in which, on the contrary, at the period of greatest excitement, you find the patient perfectly fit to be out of bed, complaining of no pain, seeming to feel no uneasiness, and manifesting perhaps little thought of food, but neither irritability of the stomach nor loss of appetite. Maniacal delirium partakes more of the idiopathic character, continues an indefinite time, persists after the removal of its supposed causes or associated physical symptoms, and rarely occurs before the age of puberty. Taking the history of the attack into account, you will not confound febrile or acute delirium with mania, if you satisfy yourself of its sympathetic origin, the great involution of all the powers of the mind, and the evident derangement of the physical as well as the mental functions of the nervous system. Delirium is the superaddition of a mental to a corporeal disorder. The best diagnostics are physical:—psychically the two conditions are much the same. The voluntary control over thought is lost in both, but voluntary motion is, so to speak, *plus* in mania, *minus* in delirium. Emotion is more perverted in the one, more obscured in the other. Perception and conception are confounded in both. In maniacal delirium there is a greater capacity of memory (the retention of impressions,) and after recovery, accordingly, a greater power of recollection; a fact not available as a diagnostic, but very useful to be kept in remembrance by those who come in contact with the insane. A person after his recovery from maniacal delirium recollects all or most of the circumstances of his illness, the wanderings of his imagination, the absurdity of his actions, and the treatment to which he was subjected; whereas, he who has been suffering from febrile delirium finds that memory has been through much of the time incapacitated; something he may recollect vividly, something indifferently, but he has an incorrect notion of the time which has elapsed, and much of his illness is a blank in his mind.

Delirium being a state of unsoundness of mind in the fullest sense, is a condition which for the time annuls civil and criminal responsibility.

The Examination of Lunatics.—The testimony given by a medical man regarding the state of mind of one who is suspected to be insane, must be derived from a personal examination. Before the interview you should take care to be furnished with a full and particular history of the case, comprehending the age, social relations, profession, and physical character of the individual; the existence or not of hereditary predisposition, or of a previous insanity, his natural cast of mind, habits, acquirements, and character; his state of bodily health, the date of the appearance of derangement, and the presumed causes of the malady; the first indications of disturbance, the order and succession of symptoms bodily and mental, the difference between his present and his former habits and character, the type of the emotional disorder manifested, and the delusions, if any, by which his conduct is governed; the actions which are most characteristic of his insanity, and the mode by which he is likely or has been prepared to understand the nature of your visit. A complete history as above will save you much trouble, and possibly the lunatic much unnecessary questioning and irritation: and in some instances be of value in estimating the worth of the opinions and observations of relatives, in cases in which corroborative evidence is desirable.

Your introduction to the lunatic should be managed in such a way as to lead him to form no prejudice against you. As a general rule it may be well that he should not suspect your object, but there will be cases undoubtedly in which it would not be improper that he should know the intention of the visit: at all events it is desirable that you should not be an object of his ill-will. In the latter case, in which he is aware that his sanity is canvassed, you should feel, and he should be led to understand this, that soundness of mind is the judgment which you are anxious to have the grounds of forming. You should conduct yourself towards him, so far as the circumstances of his case permit, exactly as you would towards one sound in mind. In all cases where it is possible and proper, your interview with him should be private, without the presence of even his nearest or most interested relative. You should not exhibit timidity, nor hide the feeling under a blustering manner; rather have the presence of some one to protect you. You are to be sympathizing, not patronizing. You are to treat him as an invalid, and not as a child, or an inferior in intellect. I am in these directions presuming that the case is one of some doubt and difficulty, and not, as is more usual, one in which the examination is chiefly a formal necessity, and requiring little tact and discrimination.

You may perhaps be able to discover pathognomonic symptoms of mental disease in the aspect and behaviour of the person, to lead you to be satisfied of his condition before he opens his mouth, more especially if he is not an entire stranger to you; but however high you may rate your power of discrimination in this way, you are never to venture a certificate solely on such grounds; you may be misled by simulation, extreme and unwonted although natural emotion, a state of excitement from intoxication, depression from physical diseases or the influence of drugs and remedies, and the physiognomy of other diseases, as for example, epilepsy, and hysterical or other nervous affections; besides, the grounds of your opinion should be such as others can comprehend and rightly appreciate. Neither are you to be guided solely by the authority and statements of others; these may direct you in your investigation, and confirm you in your conclusions, and may be cited as forming partly the foundation of your opinion, but you are always to satisfy your judgment by your own observations and examinations.

In most cases, as you are introduced to the individual who has to be examined in your character as a physician employed by his friends who are anxious respecting his bodily condition, you will find it generally most suitable to commence with an investigation of physical symptoms. Notice the conformation of the head, the expression of the countenance; ascertain the condition of the pulse, the state of the digestive function, the feelings in the head, the temperature of the scalp, the disposition in regard to sleep. Encourage him to represent his symptoms of ill health himself, the notions which he attaches to them, and the causes to which he supposes they are owing. These will frequently be obviously of an insane kind. In some cases the physical examination will afford nearly conclusive evidence, independent of the patient's own exposition of his maladies; there may be a pathognomonic countenance—shall we say also, in deference to Dr. Burrows, a pathognomonic odour not requiring to be substantiated? There may be evidence of physical ailment implying mental disorder. Had it been suitable to the objects of this class to speak of the diseases of lunatics, I should have alluded very expressly to a peculiar sort of paralysis, which even in its slight beginnings scarcely ever, or if I speak from my own experience never, exists but in combination with diseased minds. I allude to the paralysis of the insane, which you will find described in all the later writers on mental pathology, and most graphically pourtrayed in the Croonian Lectures of 1849, by Dr. Conolly.

Your investigation of the mental disorder should consist in a search for those characteristics of unsoundness which have been described. You are to seek for such changes of moral character as nothing but disease can explain; for such instances of imbecility, incoherence, and delusion, as attest imperfect mental power, disordered understanding, and incapacitated judgment, and for instances of conduct incompatible with a healthy faculty of self-control. If the patient labour under acute mania or chronic delirium you will meet with no difficulty, he will save you all necessity of searching, and furnish in a single interview more proofs of insanity than the memory can retain. If imbecility is the type of the disease, you are to look for its indications in the physiognomy, habits, tastes, and general conduct; in the powers of attention, efforts of judgment, and capacity of dealing with thoughts. You must take the education and the means of acquiring information into account: shrewd examiners have before now mistaken ignorance for imbecility. A person may be more sound in mind than Malvolio was, without knowing what opinion Pythagoras held concerning wild-fowl. If some governing delusion is sought to be exposed, you may perhaps find occasion for all your acumen; for as you are aware, monomaniacs, if their easily awakened suspiciousness be once aroused, occasionally exert no slight power of cunning and secretiveness. You must, in the first place, do all you can to obtain his confidence; if once you succeed in getting him to converse freely with you, he will gradually become communicative, and come nearer and nearer to the delusion engrossing his mind. If he should fail to do so, try to make some of his singularities and eccentricities a subject of discussion, express an interest in them, and seek for an explanation of them. If he should still fail to expose his ruling delusion, you should, from possessing the necessary key, take a judicious opportunity of introducing the subject yourself, and question him of his belief regarding it. Few monomaniacs are proof against this, however much they may wish to conceal their insane notion. I have never known one directly and persistently to repudiate his delusion; he tries, but does not succeed. When pushed to the point he displays his morbid fancy, or he manifests confusion of thought and incoherence of language in relation to it, or he expresses himself mysteriously and with reserve, or he gets angry, declines to speak on that matter, or sullenly remains silent,—a great effort to him. In all cases advantage should be taken of a lunatic's willingness to write, for even when no characteristics of insanity have been observed in his conversation, you will frequently in his letter or statement find traces of delusion, incoherence, or emotional aberration. By sympathizing with the patient you will usually succeed much better than by the most ingenious attempts to compel a display of his delusion; but sometimes, when other expedients have been unsuccessful, it may be advantageous to accuse him, so to speak, of delusion and insanity, so as to lead him to an explanation and defence of conduct which appears extravagant and irrational. Do not be over-desirous to elicit the fact of insanity according to some pre-conceived plan which you have laid down for the purpose. Allow the lunatic to take his own way of exposing his state of mind; the more the interview assumes the form of monologue on his part, and the nearer his discourse approaches to the form of soliloquy, the better.

Time will not permit me to allude to the special difficulties that may occur in the examination of lunatics. Here is a common one. You are required to give an opinion on the state of mind of one of whom you know nothing, of whom you can be told little or nothing; that preliminary history is wanting which I have said is of so much convenience. The individual has possibly been found vagabondizing, and has been laid hold of by the authorities for some slight offence. There is some reason to think that he was once under confinement as a lunatic, and on this account you are requested to investigate his case in a police cell or the ward of a prison. He is reserved and sullen, replies curtly to questions, but manifests no delusion. You can make little out of him, save that his disposition is by no means engaging, or his intellect very brilliant. In such a case you must endeavour to accumulate some knowledge of him; have him watched and conversed with, and from time to time secretly observed. If you find that he mostly occupies one place and position, that though sullen and dejected he occasionally smiles by himself, avoids his food, that at night he sleeps badly, talks and laughs to himself, stands on the floor, or wanders about his apartment, you have ample grounds for suspecting that he is the subject of some morbid delusion; but as you possess no hint of it, you may have difficulty in getting it evolved. You cannot sound his opinions on all matters of sensation and speculation, but you may chance to jangle the loose string by a judicious venture. I have had occasion to notice, as being more potent than ordinary in conjuring forth a delusion in such cases, questions relative to kindred, bodily health, sexual ideas, poisoning, unseen agency, and nocturnal feelings. There is much room for the exercise of tact, ingenuity, and sagacity, in these cases.

I have known an examiner annoyed and nonplused by the persistent and absolute silence of the person under examination. This conduct may arise from idiocy, insane abstraction, and peculiar delusion, in which instances insanity will be well marked in the aspect and behaviour of the patient. It sometimes is the consequence of mere obstinacy, or of a determination to thwart all attempts at investigation, but in every case it forms, in combination with the testimony presented, a good ground for the belief of the existence of an unsound mind.

The forms of imbecility of mind and moral insanity are perhaps the most difficult of all to investigate satisfactorily; but as we have yet to consider the subjects of civil and criminal responsibility, I shall at present delay no longer on the examination of the insane.

Lunacy Certificates.—The ordinary purpose of the examination of lunatics is to certify, that the condition of the mind is such as to require interference with the patient's liberty for the sake of fitting treatment, his personal safety, and the protection of the community. In Scotland, before an individual can be sent to a lunatic asylum, the fact of mental derangement, together with the necessity of confining the patient, must be certified by an authorized practitioner in medicine. The certificate must be given "upon soul and conscience," and all who are concerned in lodging one who is sound of mind in an asylum, or in compressing the confinement of an insane person in an irregular way, are liable to heavy penalties. Upon such a certificate the nearest relation or recognized guardian of the patient petitions the sheriff of the county to grant a warrant for removing him to a licensed lunatic house. While under confinement he is seen at will by the sheriff or his deputy, accompanied usually by a medical assistant and the procurator fiscal of the district, and he has the power of ordering the liberation of the patient whenever he may deem it unjustly delayed. The minister of the parish has also a right to visit the lunatic asylum, but no power in the way of supervision or inspection. The machinery is therefore simple, economical, and as regards the protection of those under restraint in licensed asylums, not to be charged with being ineffective; but the Scottish lunacy law is very far from being perfect, although from the successful resistance which all the recent attempts at improving it have met, it might be deemed a much more faultless institution than it actually is. Lunatics that are not paupers may be kept anywhere, and treated in any way, by any one. The public hospitals are public in a limited sense, and neither freely available for educational purposes to the profession, nor even for the care and treatment of all classes of the insane. I have known instances of disagreeable or difficult cases being rejected, and a lunatic who has committed a criminal action, and whose safe custody has become a matter of much consequence to the community, is by most of these misnamed public asylums unhesitatingly refused. They are not subjected to adequate government control, but are liable to be under the management of a body of self-elected, irresponsible, ill-chosen directors, nearly as numerous as the inmates. In some cases the hospital is but an appendage to some other institution, instead of being separate and independent, having no governing authority but that connected with the parent establishment, and therefore subject to be ruled as if it were a prison, an infirmary, or a poor's-house. Patients of various grades are admitted into houses, which in some instances have been originally designed for and are chiefly occupied by insane poor, and are even sometimes rather heterogeneously mixed. It is this proportion of private patients, however small, that constitutes the barrier to the admission of students for the purposes of instruction. The attempt is constantly being made to ape the stylo of a private asylum, and to increase the number of the better class, to the injury of the full efficiency of the hospital as a public institution, and to the prevention, of the establishment of such admirable houses for the better rank of lunatics as are common enough throughout England, but almost unknown in this part of the island.

There is an uncertainty about legal details in reference to lunacy matters in Scotland, which it is desirable should be amended. There is a want of uniformity in the constitution, charges, and arrangements of the hospitals, and if I am not mistaken, in regard to modes of procedure and the forms of warrants and certificates, much is left to the discretionary power of local officials.

The following may be received as an adequate form of a lunacy certificate in Scotland.

(Place and date—the latter in words.) I, A. B., M.D. (or surgeon,) hereby certify on Soul and Conscience, that I have this day visited and examined C. D., at present residing at ———, and am of opinion that the said C. D. is in such a state of mental derangement as to require confinement in a lunatic asylum.

(Signed) A. B., M.D. (or surgeon.)

In England there must be two medical certificates, unless in the case of a pauper lunatic, when the testimony of one medical examiner is sufficient. These certificates must be signed by individuals not partners together, not relatives of the patient, and having no professional connection with, or other interest in the asylum to which the patient is to be consigned. These examiners have to investigate the case not together, but separately, and must each in his certificate mention the facts upon which his opinion is founded. These documents must be accompanied by a printed order, filled up and signed by the relative or guardian who authorizes the patient's detention as a lunatic. When the lunatic has been received into the hospital he has to be examined anew, and reported upon to the Board of Commissioners in Lunacy. The most important difference betwixt a Scottish and an English lunacy certificate, is the specification of some of the facts on which the opinion is based, in the case of every lunatic not a pauper, a thing which seems to derogate from the professional character of the document. To give a certificate means, to render a fact sure by the testimony of adequate knowledge; the *ex cathedra* deliverance is by this mode, however, converted into the mere expression of a proposition, and the opinion propounded is not so much a judgment as a condescendence or submission of professional or presumed adequate knowledge to some other, which if surer ought to be at once applied. The medical examiner would appear not to say—this is lunacy; but—is not this lunacy? a function which might be quite as well, and rather more fittingly, discharged by others than "a physician, or surgeon, or apothecary, duly authorized to practise as such." Much latitude is allowed in regard to the statement of facts: these may be any characteristic symptoms of lunacy, as incoherence in conversation, ungoverned excitement, special delusion, noisy or indecent conduct, alteration of the natural physiognomy, or even facts which have not been observed by the examiner himself, but have been merely represented to him by others, provided this circumstance in regard to them be stated in the certificate. The following is an example of the form adopted.

I, A. B. being a physician (surgeon or apothecary,) duly authorized to practise as such, hereby certify that I have this day, separately from any other medical practitioner, visited and personally examined C. D., the person named in the accompanying statement and order, and that the said C. D. is a lunatic, and a proper person to be confined, and that I have formed this opinion from the following facts, the latter being from information derived from his relatives; viz., that he labours under a great despondency of mind, the result of the delusion that he is the victim of a widely extended conspiracy to injure him, and that he manifests a propensity to self-destruction.

Signed A. B.,
(Residence.)
(Date in words.)

In Scotland, where no grounds are required to be assigned for the opinion given that one is insane, and where the community has not the protective supervision of lunacy commissioners, it would be well either that instruction in medical pathology were made a necessary branch of medical education, or that the privilege of granting lunacy certificates should be restricted to those who could declare that they had had the means of studying the disease clinically in some hospital for insanity.

When is mental unsoundness such as to justify interdiction?—Interdiction is defined by Erskine, as a legal restraint upon those who, either through profuseness, or extreme facility of temper, are too easily induced to make hurtful conveyances, by which they are disabled from signing any deed to their prejudice without the consent of curators, who are called interdictors, and who are the nearest male relatives on the father's side, if they be of lawful age and otherwise capacitated.

When a lunatic is interdicted he is no longer free to contract agreements, execute legal deeds, or conduct his own affairs. In England, the individual having been certified to be insane by qualified medical examiners, the Court of Chancery is petitioned on this ground to appoint a special commission, to determine whether he be *compos* or *non compos mentis*. This is termed appointing a commission *de lunatico inquirendo*. This commission examines the evidence pro and con, and gives verdict accordingly. In Scotland, the lunacy certificate having been obtained, application is made to Chancery for what is termed a Brieve of Idiotcy, or a Brieve of Furiosity, (according as the person is held to be either fatuous or raving mad.) This document is addressed to the judge-ordinary of the district (the sheriff,) and instructs him to summon a jury to determine upon the individual's state of mind, and upon the male relative to be appointed interdictor. The proceedings are instituted by the nearest male relative of proper age, and with the knowledge of the person whose state of mind is the subject of doubt, and are termed "a cognition," or "cognoscing a lunatic." The lunatic must be personally examined by the jury previous to their verdict.

Interdiction is justifiable and necessary in all cases of mania, dementia, and amentia. Cases of difficulty arise in the lesser degrees of insanity, as the earlier stage of mania, the person being not raving mad, but only in a state of more than natural excitement; cases of imbecility, the person being not idiotic, but simply of weak mind, and many instances of monomania. In moral insanity interdiction is presumed to be unnecessary.

In cases of asserted imbecility, take care not to mistake ignorance, from want of education and opportunities of information, for mental defect; in cases of excitement and delusion, be satisfied that the former really interferes with voluntary control, and that the latter is not merely of a speculative and harmless charecter, but is practically exhibited in insane and ruinous conduct. The mode of investigation must vary with each particular case. In imbecility you will question the individual on matters which he has had sufficient education and opportunity to know, comparing his intellect with one cultivated in a similar degree, and if the imbecility be adventitious, the present condition of his understanding with what you can learn of its previous capacity. Test his faculty of memory, his powers of notation, his capacity of being instructed, his knowledge of money matters, of the condition of his affairs, and of the proceedings in progress. Take his moral character into account; see whether or not he have self-reliance and "a mind of his own," or be so facile as to be capable of being led in any directon by the self-interested and evil-designing. Though the capacity of a monomaniac to manage his own affairs is never increased by his delusion, still he may be perfectly competent to manage them, not in an ordinary way merely, but much better than any one else could do for him. Ascertain how his faculties and emotions are exhibited in writing, his ideas regarding matters of religion, morality, property, money, duties, and obligations. Conduct is a much better test than capacity in such cases. Before you can testify that interdiction is necessitated from delusions, be satisfied that they lead into insane and ruinous courses; that they so engross the mind as to render efforts of attention inefficient when directed to other necessary objects; that they lead to neglect of natural duties; that they occasion apathy, indifference, and neglect of worldly affairs, to the lunatic's own loss, and the injury of those naturally dependent upon him, or legally interested in him; or that they are combined with loss of memory, general mental deficiency, or morbid feelings, which lead him to pervert the application of his worldly means. There might be incapacity in business, without there being as a consequence sufficient grounds for interdiction from the management of affairs; mere incapacity to make money, and thereby a livelihood, owing to diseased mind, would by no means form a sufficient plea, although incapacity of keeping, or spending, or using it rationally, might.

Testamentary capacity of the Insane.—For a valid testament there must exist a disposing mind; that is, a mind not oppressed and governed by delusions, in which the judgment is capable of discerning, the memory not clearly impaired, and the emotions not unnatural. No one labouring under mania, amentia, or dementia, can be deemed to have a disposing mind; but it is presumed that one who is merely imbecile, or labouring under a form of partial insanity, may. Any lunatic may execute a valid testament during a lucid interval of his disease. He is incapable of disposing of his property, if his imbecility of mind is such as to interfere with a right understanding of the act, if his delusion obscures his knowledge of surrounding circumstances, and if he labours under any delusion incompatible with right feelings and rational ideas in regard to the disposal of his property. A lunatic who has been interdicted may yet be capable of making a sufficient will, because he may have enough of capacity for doing this, although he have not the degree of mental strength and activity of intellect requisite for the uncontrolled management of all his affairs. Although of feeble mind, the lunatic's imbecility would not be such as on that score to invalidate his will, if he fully and accurately comprehended the extent and nature of his property, if the dispositions in the deed were not only natural but of his own devising, and if he rightly understood the consequences of the document. Nor although the subject of delusion would the lunatic be incapacitated to execute a will, if the provisions in it were rational, in conformity with previous intention when sane in mind, and independent of the delusion. The character of the deed itself forms usually the best evidence of testamentary capacity. Should a will be written by the patient, without incoherence, irrational, unnatural, or inconsistent provisions, it will be perfectly valid, even although he was at the time undoubtedly unsound in mind, and the inmate of a lunatic asylum. It is not the insanity of the devisour, but the illegality, falsity, or insanity of the deed, that will overthrow it.

Testimonial capacity of Lunatics—Civil responsibility in reference to contracts, marriage, &c.—When does insanity justify coercion?—Cases which do not demand the restraint of an asylum—superintendence always requisite—Lucid intervals—how judged of—Recovery—the marks of recovery—Discharge of Lunatics—liberation and emancipation—Criminal responsibility of the Insane—legal test—consciousness of right and wrong—power of self-control—insufficiency of the legal test—evidence of irresponsibility—how sought to be obtained—Medical opinion—how dealt with in law-courts and by the press—insufficiency of ordinary juries to determine upon insanity—ne-

cessity for an improved mode of procedure—Punishment of the Insane—mitigated penalties—dispunishable conditions—Does Insanity diminish the expectation of life.

Testimonial capacity of Lunatics.—I concluded last lecture with some remarks on the testamentary capacity of the insane, and shall now allude to their testimonial capacity. Those who labour under amentia, mania, or dementia, are unfit to give evidence as witnesses, but the evidence of those labouring under partial insanity may sometimes be admissible. The testimony of a lunatic during a lucid interval in his disease, is received in reference to matters which have occurred during the existent intermission, and which he may be supposed fully to comprehend; but should a paroxysm have intervened betwixt the events and the time that the testimony is required, then his evidence will be held as of little or no value, because it is presumed that the mental attack may have dissipated or distorted his recollection. The testimony of a monomaniac about matters unconnected with his lunacy may be good, but so liable are the emotional faculties to be perverted in such patients, and so difficult is it to be satisfied of the non-influence of the governing delusion, which may act in the most unsuspected ways, that the testimony, if uncorroborated, is of small value, and even though it stand the tests of recapitulation and cross-examination, should be admitted *cum nota* and with much caution. There are delusions which would incapacitate the witnessing of those possessed by them on any subject. I have more than once known one puzzled to determine without investigation whether the insane statement of an asylum patient were truth, mischievous falsehood, or pure lunacy; so unexpected, yet so plausible, circumstantial, and consistent, has the story been. The testimony of an individual who has truly recovered from insanity, regarding the circumstances of his illness or the events which preceded it, I believe to be very much more trustworthy than the evidence of a lunatic during a lucid interval, regarding even the circumstances occurring during that interval.

Civil responsibility of the insane in reference to contracts, marriage, &c.—Civil contracts entered into by those labouring under general insanity would be void, but in cases of partial insanity a legal agreement is not of necessity void if it be not the consequence of disordered mind, but fair and rational in its character, and accepted or proposed by one ignorant and unsuspicious of the existence of the insanity.

A marriage contracted in a state of general insanity would be illegal and void, as those afflicted by such a state are incapable of a lawful consent. In regard to marriages contracted by those partially insane, there is not an absolute rule. If the marriage were in any way a manifestation of insanity, as the result of insane delusion, or were contracted during a lucid interval by an interdicted lunatic, or were brought about by the collusion of interested parties, the insanity being on the one hand fraudulently taken advantage of, or on the other unsuspected or misrepresented, the agreement might be annulled at the suit of the party injured or misled. Very mad people do sometimes get wed. I have known an instance in which a female was married when in a state of absolute mania. She was under treatment and difficult to control beforehand, and much excited at the time of the ceremony, but next day she was perfectly ungovernable, and had to be sent to a lunatic system. Being in indifferent circumstances her maintenance had to fall on the parish, but whether on her husband's or her own became an interesting question. The business went forward in spite of the representations of her medical attendant; the relatives insisting that she was merely what is sometimes called hereabouts "carried," and would get sobered down by being married; the bridegroom that she was crossed and irritated by her friends, and would become quiet and tractable when removed to her new home. You will find it stated, that the behaviour of the person at the time of the ceremony will form evidence of the mental condition and of the validity of the marriage; but in Scotland, where the ritual part of the affair is, as concerns the parties joined, a much more passive matter than it is in England, briefly and privately performed in the bride's house, there is not the same opportunity for extravagance to be manifested; and in this particular case the clergyman, who was unwitting of the true state of matters, although things looked something queer, saw nothing in them, as he thought, for the short time he was occupied, but what perhaps he had seen on other such occasions—the effects of a rather premature and incautious indulgence in good cheer.

When does insanity justify the coercion of the patient?—In what cases are we justified in certifying that an insane person's condition is such as to require his confinement in a lunatic asylum? It has been said that no lunatic should be placed under restraint who is neither dangerous to himself nor to others; but both medical and legal practice will authorise more than this. A lunatic may be lawfully restrained for his own or others' protection, for the control of his conduct, for the requisite care of his person, and for the treatment of his disease. You will be justified in certifying that a lunatic is a fit subject for confinement in an asylum upon any of the following grounds, if these cannot be efficiently dealt with by any other course:—viz.,

To protect him from external danger.
To keep him from injuring himself.
To prevent him injuring others.
To prevent him from injuring property.
To obviate a propensity to criminal, indecent, and riotous conduct.
To guard him from maltreatment and neglect.
To subject him to efficient treatment for the cure of his disease.
To subject him to efficient treatment for the alleviation of its symptoms, when the disease is incurable.

Before adhibiting your name to "soul and conscience" documents, testifying confinement to be required, be sure that you recognise the existence of some of these foregoing grounds, in combination of course with the fact that the patient is truly insane. Imbecility of mind, or delusion, does not of itself justify restraint; it is the medical necessity of the case, or the loss of control in the patient, which does so; and even these in special cases may be dealt with otherwise than by confinement in an asylum. In addition to the medico-legal question of restraint, there is a medico-ethical one in regard to its mode. If an insane person be quiet in his conduct, easily directed and superintended, labouring under an incurable form of the malady, and in such circumstances as to be able to afford all necessary expense for comfort and attendance, a medical man should be shy of becoming a party to the confinement of such an individual to an asylum. The good of the patient is the object to be kept in view. Station in life makes an important practical difference in the matter. A poor man when he becomes insane becomes a burden upon others for his maintenance, and however quiet, harmless, and incurable he may be, it is necessary for his due protection and comfort that he should become the inmate of a public hospital. Cases of senile dementia in the better ranks of life do not require confinement. In cases of puerperal insanity also, a lunacy certificate should be a matter of serious consideration, as this form of disordered mind is most frequently curable, and that within a short period. In the better ranks insanity arising from such a cause is more likely to be speedily removed by judicious medical treatment at home or in a private family than in an asylum, and the patient will, after recovery, be in every case found to be highly pleased that the one course was adopted in preference to the other. I might go on to cite many examples in proof that it is not always either good judgment or fair play to consign a lunatic to the safe keeping of the walls of a lunatic asylum, though it must be admitted to be in most instances, and on the patient's own account, a right, a politic, and an unavoidable measure.

Although restraint in an asylum is not to be accounted necessary in every case of insanity, superintendence and control is requisite in all. Every one who is lunatic ought to be reported to and known by the authorities, if not under confinement; and no one labouring under insanity ought to be permitted to wander about at large by himself, for it is impossible to predict the actions to which he may be impelled in consequence of his mental disease. Although we may be supposed to have sufficient knowledge of the features of his case to measure the extent of his understanding and his amount of self-control, and imagine ourselves able to enumerate all his delusions, yet we cannot foretel or reckon upon the morbid actions to which he may be suddenly led, by insane ratiocination or diseased impulse.

Lucid intervals.—What constitues a lucid interval? During what is termed a lucid interval, the lunatic is held to resume the civil position of a sane person, and may enter into an agreement, give evidence, make a will, &c. He is also presumed to be again responsible for his actions. A lucid interval is an intermission of the disease for a longer or shorter period, and is not a necessary, neither a common occurrence, even in acute cases. Such intermissions are never observed in amentia, imbecility, or chronic dementia,—are very rare in monomamia, and occur most ordinarily in cases of maniacal excitement. They have to be distinguished from remissions. Remissions have that frequency amongst the insane which legal writers falsely assume for lucid intervals; wherever there exists any degree of excitement or depression, there are remissions. They are observable, therefore, in the great majority of lunatics—indeed in every case of insanity, whether chronic or recent, which does not simply consist of congenital mental deficiency: remissions are very common, lucid intervals rather rare. In judging of a lucid interval, the best course to pursue will be to get the patient to exhibit his powers of mind in writing, and then to have a personal interview, in which the history and features of his own case should form the chief matter of conversation. If the personal examination be satisfactory, and also the character of the epistles, and if you find that his feelings and emotions are no longer morbid, but natural, you may safely certify that you consider the condition to be at least a lucid interval, but I would advise you in no case to do so solely upon the grounds of apparent intellectual sanity—the mere absence of incoherence and delusions. A first lucid interval is not to be distinguished from a recovery by its features, but may frequently be suspected from the suddenness of the improvement. The shorter the interval which marks the particular case, the less are you to depend upon the integrity of the mind during the state of calm. The truest lucid intervals most usually occur about regular periods, and last for several weeks or months; they are generally of longer duration than the paroxysms, but as the disease progresses they come at longer intervals and less regularly, they have a shorter duration and are less perfect, having more the character of remission than intermission. The first fully developed intermission is the interval which is most lucid. There is occasionally a very short lucid interval preceding death, which I have not myself witnessed but in some instances of recent acute mania, in which the excitement was so violent as to prove speedily fatal by the exhaustion of nervous energy. The patient, after suffering for two or three weeks from a state of sleepless, unceasing, and extreme frenzy, falls into a typhoid-like condition, manifests a return of soundness of mind, and shortly expires.

In regard to lucid intervals the law exercises a praiseworthy caution. The evidence of sanity must be as clear as were the proofs of disease. Though the validity of a will executed in such a condition has been frequently upheld in law courts, there is no example of any one having as yet been punished for a crime committed in such an equivocal state of soundness, as an intermission of insanity must be considered to be. In all lucid intervals which are not actual recoveries, it is to be presumed that though the symptoms of the malady are for the time inappreciable, pathological causes of the disease still remain. The flame has gone out, but the inflammability continues, and the slightest cause may be sufficient to evoke the fire again before it would of itself burst forth. "Burdened as the criminal law is," says Dr. Ray, "with false principles on the subject of insanity, the time has gone by when juries will return a verdict of guilty against one who is admitted to have been insane within a short period of time before the criminal act with which he is charged."

Recovery.—When is a person to be held as having recovered from an attack of insanity? The following are the grounds which will justify this conclusion.

First, The return of the natural complexion and expression of countenance, and the disappearance of the signs of related physical disorder.

Secondly, The absence of intellectual disorder,—delusion and incoherence; the patient being capable of recognizing his insanity, and conscious of its removal.

Thirdly, The absence of excitement, manifested in the return of adequate self-control.

Lastly, The restoration of the emotional faculties to their natural character, the return of the benevolent emotions, the feeling of sympathy for others, the love of kindred, &c.

Such changes in the patient indicate the removal of the pathological causes of the disease, the re-establishment of the understanding, and the restoration of his moral faculties to their healthy tone. When they all concur, you may be satisfied that the patient has recovered from the attack of insanity, but if any one of them be wanting, you must consider that an essential step still remains to be made. It very seldom happens that a patient recovers in one or two of these points without recovering in them all, but it does so happen occasionally, and gives rise to no little difficulty in determining upon the continuation of restraint.

When once a person has been found lunatic by commission, or his insanity declared in any other published form, the law is very jealous of allowing him to resume his civil freedom, and requires the clearest substantiation of the fact of recovery, before the commission is superseded and free enlargement allowed. To certify a lunatic's recovery you ought to make as scrupulous and careful an examination as you have been instructed to do before becoming concerned in a certificate of lunacy. Be careful not to mistake partial for complete recovery, and remission or intermission of the disease for absolute removal. Unless the patient has recovered in every particular above mentioned, you may be certain that he will not remain stationary after his enlargement, a man with a new personality; and in the generality of instances the chances of relapse are much beyond those of confirmation. As a general rule, you may be doubtful of the stability of recovery directly as its suddenness. If the disease has come on gradually, be sure that it will be still more gradual in its retiring. Every cure has to be tried by the test of time, and should the disorder have manifested the recurrent type, the proof must be a slow one in order to distinguish betwixt lucid intermission and recovery. The distinction of cure and intermission is however more medical than medico-legal, but it is one of importance in reference to the full emancipation of the patient.

Discharge.—When should a lunatic be removable from confinement? It is to be wished that the law with us in Scotland were somewhat explicit on this subject. In the present state of matters, any insane person who is confined in an asylum may be removed at any time by those who have obtained his confinement; the consequence of which is, that many who are progressing favourably enough may be made, through the mistaken conduct of friends often not strong in judgment themselves, hopelessly incurable, and not a few come to perpetrate criminal atrocities. No lunatic should be consigned to an asylum who does not need to be so, but having required this, for any of the reasons previously alluded to, his enlargement should be obtainable only by petition and warrant on sufficient grounds, in the same way as his constraint was effected. In addition to the plea of recovery a patient might be removable for better treatment elsewhere, or be discharged because he is incurable and harmless, or in a lucid interval which former experience has shown may be longer than his paroxysm, but in no case, unless in that of thorough recovery, ought discharge from confinement to imply full emancipation from control. Even in some cases of recovery it would be well if perfect freedom were to be interdicted, as, for example, when insanity has resulted and recurred from drunkenness, for in every such case, without careful superintendence, discharge is certain relapse, and freedom a foolish and a cruel gift, precipitating its unfortunate possessor, with every exercise of it, deeper and deeper into the darkest gulph of madness. There should also be a control exercisable by competent authority over the managers of public asylums, to prevent them also from dismissing lunatics, unless upon grounds that are satisfactory to those who have entrusted them to their care, and to the sheriff on whose warrant they accepted the trust.

Criminal responsibility of the Insane.—Theorists have occasionally run mad on the subject of criminal responsibility. Some have held that punishment should in every instance overtake crime by whomsoever committed; others that punishment should follow crime in no case, all crime being a result of faulty or diseased organization. Dr. Heinroth of Leipsic's insanity was, that all disease depends on sin, therefore instead of being a plea for exemption from punishment, is but the more a proof of guilt.

An English judge tells us, that medical men have the delusion that insanity renders a man dispunishable, which is a delusion of the bench; such a mistake is not to be found recorded by any English medical authority. The insane we all know may be legally punished, whether justly or not. There is an insanity which annuls criminal responsibility, and an unsoundness which leaves it unmitigated. How are these distinguished? The law directs the application of the following test:—Was the individual's disease of the mind such as to make him incapable of distinguishing right from wrong at the time he committed the offence? if so, he has a criminal capacity; and if otherwise, he is not guilty on the ground of insanity. The phrase "right and wrong," may be read lawful and unlawful, legal and illegal, and the person be supposed irresponsible, either on the ground of perverted moral sense, thinking wrong right, or of obscured intellect, being incapable of remembering and reflecting, and having no right consciousness of the relations of things. How is this knowledge of the criminal's mind to be got? It is sought for by an investigation of the history of the offender previous and subsequent to the act, in order to discover the character of his immediately antecedent or subsequent conduct. The fore or after existence of diseased mind, and the value of the indications of it, are referred to medical opinion. The deduction as to the consciousness or unconsciousness of right and wrong in regard to the act itself, is left to the jury.

Now let us consider this test, and the way it is managed. The test is sufficient in cases of amentia, mania, and dementia, the patients in such forms of insanity manifesting in their general conduct evidences of non-development or disease, and clear incapacity for competent ethical or metaphysical distinctions, but is I believe incapable of application or insufficient in cases of partial insanity, the sole cases in which difficulties occur, and special tests are desirable. On the one hand, we may suppose an individual unconscious of right and wrong, and yet not the subject of disease, the voice of conscience being silenced by vice, or perverted in its sound by false training, false reasoning, false principles; on the other hand, and here we do not presume, but assert, a person may be conscious of right and wrong, and yet not be a proper subject of punishment. Before a person can be deemed responsible for his actions, he must not merely have the power of *distinguishing* right from wrong, but the power of *choosing* right from wrong; a criminal being properly punishable, not because he knew good from evil, but because he voluntarily did the evil, having the power to choose the good. If a special test of insanity were to be insisted upon, the power of self-control, as being the true index of responsibility, would seem to be better than that of the integrity either of consciousness or conscience. Had the lunatic, at the time of committing the deed, a knowledge that it was a criminal one, and such a control over his actions as might, if exerted, have hindered him from committing it? Most lunatics have an abstract knowledge that right is right, and wrong, wrong;—as much of it as should keep them from being guilty of unlawful deeds, were but such knowledge sufficient for that end,—but the voluntary power over actions and thought is in every case impaired. I do not say that free agency is annihilated; this were untrue; there could then be no moral treatment of insanity; but it is much limited, and overruled by various insane motives. Lunatics have that amount of freedom of will, which it is philosophical, charitable, and advantageous to recognise for their benefit, but at the same time such a defect of free agency as makes the full burden of responsibility to imperfect human legislation, a discreditable and unjust oppression. Many of them may be fully accountable *in foro conscientiæ*, but in all other courts, if the insanity be apparent, the defect of self-control should be presumed to exist, and the individual condemned to restrain, or, if considered liable to punishment, subjected to only a mitigated penalty. There are many states of insanity in which the will is not completely fettered. When the disease is commencing, the will may often be observed struggling before it is overcome; indeed, a highly energetic will may prevent insanity, it may uproot or control a delusion. When the disease is retiring, the will may also be observed gradually reasserting its authority over the morbid fancies. Here is an example. A recovered patient, to whose narrative I have more than once referred, was directed in his illness by voices which he heard misleading him. They told him that he was in heaven, and he believed them; that such and such an individual was the Son of God, and the person became to his belief the Divinity; but by and by we find that the voices talked to him in a very singular strain; they said, "You are in a lunatic asylum, *if you will;* if not you are in such and such a place."—"That person is Samuel Hobbs, your attendant, *if you will;* if not he is the Saviour." In short, he was beginning to recover from his delusions, or rather from the manifestations of them; his madness was becoming a matter of his own choice; his will was becoming free, and the state of responsibility returning.

In order to uphold the inference of the unconsciousness of right and wrong, when the plea of insanity is urged, evidence is sought of the existence of a sufficient degree of delirium, delusion or imbecility of mind, either antecedent or subsequent to the action. No direct conclusion on the point is allowable from the character of the act itself, and on this account it may happen that the best evidence of insanity is rejected; indeed, cases of undoubted insanity from time to time occur, in which there is no sufficient evidence of the morbid condition, apart from the circumstances of the criminal act for which the person is tried; and it sometimes will happen also that these are so extraordinary in their kind, as to compel a verdict of insanity, despite legal orthodoxy. The important point of hereditary predisposition has been objected to as part of the evidence in defence, but I conceive that the danger to be dreaded from allowing such a circumstance its due force, is quite counterbalanced by the chance of injustice which may result from its rejection. Delusion is no adequate plea in any case where it cannot be shown to have impelled the criminal to his crime: in this rule, if absolute, there is manifested the little knowledge that may lead to much error. An insane act is the index in most cases of a delusion, yet the motive may not be apparent though the result is, and the delusion which seems merely to be co-existent with—not related to the act—may yet be impulsive; for the connection betwixt an act and a delusion is often of a most insane kind, not to be surmised, nor understood when known, but existing nevertheless. Even when the crime is shown to be a morbid result, it may not be a legally sufficient plea for exculpation; for, on the "right and wrong" principle, it matters not that the act flowed from a delusion, if the person was at the time aware of its illegality and its consequences.

The medical witness is not much to be envied when summoned for the defence in cases where the plea of insanity is raised, for though his opinion on the existence of insanity be worth that of jury and judge together, it may be suppressed by the bench, in some manner not very complimentary, and ignorantly assailed in the criticisms of the press. I declare it to be impossible for any one to tell you with certainty what is allowable medical evidence in such cases. Do such and such facts in the evidence, or such and such facts in the case, indicate insanity? Was the prisoner insane at the time that the act was committed? Was he labouring under delirium or delusion? Could the crime have flowed from his insane notions? These are all questions which the judge would probably object to, or find fault with being answered, if they were put, as they have been, by counsel. The ordinary objection is, that to question the medical man so, is to make a jury man of the witness: this does not seem a sufficient reason, for the opinion conveyed in the answer, though a scientific opinion, is not a verdict or declaration, unless the jury see fit to adopt it. Scarcely an instance occurs of acquittal on the ground of insanity, in a case of much public interest, that the medical evidence is not impugned by smart editors, in astonishing leaders on the incompetency of medical knowledge in such matters, and the punishable capacity of the insane. The proceedings and decisions in our courts in cases of diseased mind are discreditable to the judicature of the age; the dogmas of the law stand in much need of being reconsidered, and the whole course of procedure amended. It is by the influence of medical and not of legal expositions, that the desired reforms are likely to be brought about. "The same courage," says Dr. Conolly, "which causes the physician to brave the dangers of pestilence, should support him in this duty, beneath the assault of pestilent tongues and pens. Not the voice of the people calling for executions, nor the severities of the bench, frowning down psychological truth, should shake his purpose as an inquirer and a witness. His business is to declare the truth. Society must deal with the truth as it pleases."

The jury determine on the guilt of the offender, which they are understood to do by solving the question of consciousness of right and wrong. To do this, they are not of necessity permitted the light of a scientific opinion on the point. Without adequate knowledge of the phenomena of diseased mind, and unguided by those who are familiar therewith, it is not to be wondered at that great mistakes are made, that verdicts are inconsistent with the evidence brought forward, and that parallel cases are decided in opposite ways. It would be better that the ordinary assize determined on the mere fact of the commission of the crime by the accused,—on the guilt of the person apart from the insanity,—and that the responsibility of the offender should be a matter for the after consideration of a special jury. When a presumed lunatic commits an offence, let him be tried first on the charge, and be entitled, on the certificate of his mental state by competent examiners, to appeal against sentence, on the ground of insanity; then let his mental condition be testified to, and proved before a jury specially qualified to understand and appreciate the evidence. Such a jury might, as suggested by a writer in the Journal of Psychological Medicine, consist in England, of the Lunacy Commissioners, and of medical men experienced in mental disorders. The matter to be investigated should be the diseased or defective condition of the offender, and whether it be such as to limit or annul his responsibility. The evidence should be obtainable from the history previous to the crime, the circumstances of the deed itself, the history subsequent to the crime, and the personal examination of the prisoner.

A lunatic who is found guilty of a capital charge, ought to be, and generally is, confined for life in a lunatic asylum. When the crime is of less magnitude, the confinement should be until recovery, and for a certain length of time beyond it, in order to prove the stability of the cure; before enlargement the patient should be certified to be sane in mind by competent examiners, and the evidence of recovery tested by a special jury. Some have advocated the punishment of all partial lunatics who commit offences against the law, on the principle, not merely of example to all, but also on that of deterring more particularly those who are disordered in mind from giving way to criminal impulses. For the former object we have unfortunately opportunities sufficient, without dealing by disease as if it were a crime, and the latter is not capable of being affected by such irrational means. Oh! but punishment is found to have its advantage in hospitals, as part of what is called the moral treatment of the insane. It may be so, perhaps, but then it is punishment of a beneficial kind, applied to the lunatic himself, and not inflicted on his fellows for his warning and improvement. No lunatic will be edified and improved by the punishment of an insane offender, for he will not consider himself as in the class for whom the experiment is specially intended. If capable of being deterred, the example of the penalty endured by those who are truly criminal will amply suffice for the purpose. An insane criminal action is committed either in delirium—the patient not knowing what he is about; in delusion—the offender believing the act to be not criminal and avoidable, but necessary and right; or in obedience to diseased impulse, when to choose and to do otherwise is impossible. Under peculiar circumstances, a lesser than the ordinary penalty might be inflicted on the partially insane, just as we see occasionally ordered by magistrates for children under the age of full responsibility; but in general, I believe the punishment of lunatics to be useless for any good purpose,—a mistake and a folly, if not even a sin.

To conclude. As a general rule a lunatic is properly dispunishable, because disease has restricted or destroyed his capacity as a free agent Every lunatic should be under control, to prevent him from illegal actions. No one labouring under amentia, or mania, is a fit object of punishment. A monomaniac ought not to be punished, when it is found that the crime has flowed out of the governing delusion; when the connection betwixt the two cannot be traced, if punishment is awarded, the penalty should be a mitigated one. The morally insane should not be punishable to the extreme. No one labouring under secondary dementia ought to be accounted punishable; and in no case of imbecility, in any degree, should punishment be to the extreme.

Does Insanity diminish the chances of life?—Lunatics are more liable than others to the whole class of nervous disorders, and especially to epilepsy, apoplexy, and paralysis. The peculiar condition of a lunatic's nervous system renders other disorders, with which he may become casually affected, more liable to have a fatal termination. I must tell you, however, that some have held an opposite opinion. It has been asserted that insanity does not reduce the chance of life below the averages. Independent of its complications, there are many grounds for considering that insanity is a condition unfavourable to longevity; instead of enlarging on these, however, I shall rather lay a proof of the proposition before you. The average age at death, in the York Retreat, was under 48 years; the average age at which the disorder was manifested, was 38. Now says Mr. Thurnam, the able statistician of that hospital, the expectation of life at 38 years of age according to the most recent researches, is not less than 28 years, so that the mean age attained should have been 66, instead of 48. The average age at which lunacy appears is 38, at which age the expectation of life is 28 years more; but the average age of lunatics at death is 48,—only 10 years more—instead of 66; hence, insanity shortens life. In 126 fatal cases of insanity in the Aberdeen Asylum, the average is, I find, 46 years nearly. The statistical tables of the York Retreat lead to another conclusion, less expected which also shows the unfavourable influence of the disease on the chances of life. It is this: the duration of life is not of much higher value even in those who recover, for the average age at death in those who had been discharged recovered was 57, instead of 66, or nine years less than the average probability. The subject is of much importance in connection with life-assurance.

THE

HEART AND ITS DISEASES.

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Introductory remarks—Shape of the heart—Divisions of the heart—Circular and longitudinal grooves—Position of the heart—Relations of the heart—Region of the heart's superficial dulness—Connexions of the heart—Chambers of the heart—Mode of opening the heart to display its interior—Description of the right auricle—right auriculo-ventricular orifice—Description of the right ventricle—Tricuspid valve — Pulmonary orifice—Sigmoid valves—Sinuses of the pulmonary artery.

THE heart, the central organ of the circulation, by which the blood is transmitted to the lungs, and to the remotest parts of the body, and to which the blood from the lungs, and from every part of the system, is returned, is a hollow muscular viscus, divided in its interior into several distinct compartments, covered externally and lined throughout by serous membrane; situated in the middle mediastinum, near the centre of the cavity of the thorax, about the junction of the superior with the two inferior thirds of the body; lying between the lungs and the two layers of pleura which constitute the mediastinum, and enclosed in a proper fibro-serous capsule, the pericardium.

The heart occupies the first place in the circulatory system; its functions yield in importance to no other organ, for life is dependent upon its regular and constant action, and the healthy exercise of the functions of every other organ mainly depends upon its integrity. Hence its physiology and pathology have always constituted subjects of the highest interest to the medical inquirer, and its diseases have occupied the pen of some of the brightest ornaments of the medical profession.

Although much valuable information upon various points connected with our subject existed previous to the discovery of auscultation, much, also, it must be confessed, remained unknown. Laennec's beautiful discovery opened up an altogether new means of investigating the diseases of this organ; it added, in fact, a new sense to our other methods of detecting and distinguishing between them; and it gave an impulse to the study of diseases of the thoracic viscera which has continued unabated to the present day. So that there are scarcely any other organs the physiology and pathology of which have made more rapid advances, and the present state of our knowledge of which so remarkably contrasts with that which prevailed at a period comparatively recent.

If it be true, as a general rule, that abnormal conditions of organs cannot be recognised or distinguished without a knowledge of what constitutes their healthy state, and that derangement of function cannot be explained without an acquaintance with the functions in health, to no organ does this so peculiarly or with such force apply as to the heart; and yet, until within a few years, we had little positive information upon points apparently so simple as the size and weight of the healthy heart: erroneous opinions likewise prevailed respecting the thickness of the walls, the capacity of the cavities, and the diameter of the orifices of the healthy heart; and nothing certain was known as to the mechanism by which its sounds are produced.

It is obvious that unless correct ideas on these heads are entertained, we shall not be in a position to decide whether the parietes of the heart are hypertrophied or attenuated; whether its chambers are dilated or preserve their normal dimensions; or whether its orifices are increased or diminished in diameter. Unless the exact size and shape and position of the heart are known, deviations from its normal condition are liable to be overlooked, or functional derangement to be mistaken for organic disease; and unless we are familiar with the normal sounds of the heart, with the situation at which they are best heard, and with the mechanism by which each is produced, we shall not be in a position to recognise abnormal sounds, much less to trace them to their source, or to determine their cause.

I propose, therefore, previous to entering upon diseases of the heart, to consider briefly the anatomy and physiology of this organ; to describe its exact position, and the relation of its several parts to points upon the surface; to give a summary of the researches which have been made respecting its weight and size, the thickness of its parietes, the capacity of its cavities, and the diameter of its orifices, and to notice shortly the relations and connexion of its investing membrane, the pericardium.

Shape of the heart.—The shape of the heart is almost too well known to require description; the older anatomists compared it to a pyramid, or to a flattened cone; but a flattened cone (as Winslow remarked) is not a cone. The heart, taken as a whole, has not a regular geometrical figure; and as the term *cordiform* has been generally adopted, and is familiar to most persons, it will be sufficient to say that the heart has a cordiform shape, the auricles forming the upper and broader part, the ventricles the lower, narrower, and more conical part; this conical form of the ventricular portion of the organ being produced by the peculiar arrangement of the muscular fibres which go to form its walls.

The base of the heart is formed by the auricles, its apex by the left ventricle alone, as the right ventricle does not descend as low as the left. The anterior surface of the ventricular portion of the heart is convex; the posterior surface, which rests upon the diaphragm, is flattened. The left border or edge of the heart is obtuse and rounded; the right edge is more acute.

Divisions of the heart.—The heart, although apparently a single organ, is in reality double, and consists of two symmetrical hearts joined together, each with its own system of vessels, each circulating a different kind of blood, and each performing a distinct office; the one circulating the blood through the lungs, the other through the system; the one receiving and transmitting venous, the other arterial blood, but both simultaneously performing their functions.

One of these divisions of the heart is termed the *right*, the other the *left* side of the organ; but, from their relative position, the former should rather (as was long since pointed out by Winslow) be termed the anterior, the latter the posterior side of the heart. These terms are retained from the earlier anatomists, having been applied at a period when the knowledge of anatomy was derived chiefly from the dissection of animals, in which the heart always lies vertically in the chest, not obliquely as in the human subject. Each of these divisions of the heart consists of two cavities, an auricle and a ventricle, which communicate with one another but have no direct communication with their corresponding cavities: the auricle on both sides is above, the ventricle below.

The parietes of the right side of the heart, particularly of the ventricular portion, are much thinner than those of the left; the right ventricle has merely to transmit its blood through the lungs, while the left has to transmit its blood throughout the system. The pulmonary artery, likewise, has thinner coats and more delicate valves, than the aorta, evidently because so much power of resistance was not required.

The right side of the heart, owing to its receiving and transmitting dark or venous blood, was named by Bichat, "cœur à sang noir;" the left side, from its receiving and transmitting red or arterial blood, was termed by him, "cœur à sang rouge." The right auricle is sometimes termed the sinus of the venæ cavæ; the left, the sinus of the pulmonary veins. The right ventricle is sometimes termed the pulmonary ventricle; the left, the aortic or systemic ventricle.

Circular and longitudinal grooves.—The distinction between these parts is marked by grooves upon the surface of the heart; two of which are longitudinal, and one circular. The anterior longitudinal groove runs from the base of the ventricles to the right side of the apex of the heart, dividing this part into two unequal halves: in it, the principal division of the anterior or left coronary artery is lodged. Upon the posterior surface, a similar groove, which divides the ventricular portion of the heart into two nearly equal parts, lodges a large branch of the posterior or right coronary artery. These grooves, which are often in a great measure obliterated by adipose tissue, mark pretty exactly the site of the septum ventriculorum. In some instances, owing to the anterior longitudinal groove being continued through the apex, this part has the appearance of being double or forked. Morgagni found this well marked in five out of eighteen subjects which he examined for the purpose. The circular groove, which runs round the heart between the base of the ventricles and the auricles, lodges the trunk of the posterior or right coronary artery, and a large branch of the anterior or left coronary artery: it marks the line of separation between the auricles and the ventricles.

The fat which accumulates upon the surface of the heart is always first deposited in these grooves: in the circular groove first; next in the anterior; and next in the posterior longitudinal groove: when a larger amount occurs, it will be found also along the thin edge of the right ventricle, and upon the margin of the appendices of the auricles, particularly the left. It is usually met with in persons who have a general tendency to obesity; but a considerable amount is occasionally found in subjects dying of chronic disease, accompanied by the absorption of all the subcutaneous fat. Fat is altogether absent in the heart of the infant, and M. Bizot has shown that sex has some influence upon its deposition, as it is more frequent in the female than the male; and this holds good even in diseases accompanied by much emaciation: thus in eleven males who died of phthisis, fat was completely absent in six; while in twenty-six females who died of the same disease, it was completely absent in only three.

Position of the heart.—In order to determine the exact and the relative position of the heart, the most eligible plan to adopt is to dissect away the soft parts from the front of the chest, with the intercostal muscles, in a subject where the parts are perfectly healthy: the pericardium being then laid open, the position of the heart, and the relation of its several parts to fixed points upon the surface, can be readily determined.

The heart is situated obliquely in the cavity of the thorax, from above downwards, from before backwards, and from right to left: it lies behind the middle and lower bone of the sternum; also behind the cartilages of the 3d, 4th, and 5th right ribs near the sternum and the cartilages of the 3d, 4th, 5th, and 6th ribs on the left side; in front of the bodies of the 6th, 7th, and 8th dorsal vertebræ; and immediately above the diaphragm, upon the cordiform tendon of which it rests, the serous layer of the pericardium only being interposed.

Owing to its oblique position, the base of the heart looks upwards and backwards towards the right shoulder, its apex downwards and forwards towards the space between the cartilages of the 5th and 6th ribs on the left side, where its impulse may be felt during life. In the early period of intra-uterine life the heart lies vertically in the chest, as in mammalia generally: it is not until the beginning of the fourth month that it commences to assume the position which it afterwards retains.

Relations of the heart.—In the healthy chest, the heart is overlapped laterally, and in a great measure in front, by the lungs; posteriorly the œsophagus and descending aorta lie between it and the bodies of the dorsal vertebræ. Inferiorly the heart rests upon the cordiform tendon of the diaphragm, the serous layer of the pericardium only being interposed. The base of the heart is on a line with the interval between the cartilages of the 2d and 3d ribs: its apex is a little below the 5th left rib, slightly to the left of the junction of this rib with its cartilage. During life its impulse is felt between the cartilages of the 5th and 6th left ribs, at a point about two inches below the nipple (in the male,) and three inches to the left of a vertical line through the centre of the sternum; the nipple in the adult male being immediately opposite the lower edge of the fourth left rib, a little more than an inch to the left of the junction of this rib with its cartilage.

Region of the heart's superficial dulness.—The anterior border of the lungs in the healthy subject corresponds above to a vertical line through the centre of the sternum: about the middle of this bone, and pretty nearly on a line with the cartilage of the fourth ribs, the margins of the opposite lungs begin to separate from one another, the line of the left being much more oblique than that of the right. Thus, a small portion of the heart's surface is uncovered by lung, which has a triangular shape, the base below, the apex above: it consists of a portion of the apex of the right ventricle, and part of the left ventricle near its apex. This triangular space is seated on a plane below the nipple and the fourth rib: its base is on a line with the cartilage of the sixth ribs; its right boundary is nearly a vertical line through the centre of the sternum; its left an oblique line through the cartilages of the fifth and sixth ribs on the left side. This is the part of the præcordial region where the heart is in contact with the parietes of the chest, and where a dull sound is yielded by percussion.

The relations of the lungs to the heart, and consequently the amount of the surface of the heart which comes in contact with the parietes of the chest, are altered, it must be recollected, by respiration, particularly by a forced inspiration or expiration: they are likewise materially altered by disease. On a full inspiration the lungs expand, and the heart is more overlapped by these organs; at the same time the contraction of the muscular fibres of the diaphragm draws downwards its central tendon (to which the pericardium is attached,) and with it the heart: hence the region of the heart's dulness will be both diminished laterally and will be on a plane lower down than natural "The deepest possible inspiration, however, even in cases of emphysema, never (according to Dr. Sibson) obliterates the region of the heart's dulness." It is often, under such circumstances, quite below the sternum, and behind the xyphoid cartilage, and the cartilages of the 6th, 7th, and 8th left ribs." On a full expiration, the volume of the lungs is diminished, less of the heart's surface is overlapped by them, and the region of the heart's dulness will be enlarged laterally; while, owing to the ascent of the diaphragm, and the diminished volume of the lungs, it will be on a plane somewhat higher than natural. In persons with narrow chests, the region of the heart's dulness is almost always greater than in individuals with broad and expanded chests.

Connexions of the heart.—The heart, I have said, rests upon the diaphragm: it is connected to it by the fibrous layer of the pericardium which is inserted into the cordiform tendon, as well as by the serous layer which lines the central aponeurosis of the diaphragm where the fibrous layer is deficient. It is still further connected to it by the ascending vena cava; the orifice in the tendinous portion of the diaphragm by which this vein passes from the abdomen to the thorax is close to the junction of the inferior cava with the right auricle of the heart; and the tendinous fibres which come off from the margin of the foramen in the diaphragm proceed upwards and downwards upon the anterior, posterior, and lateral surfaces of the vein, and unite the two parts very closely together. The opening in the diaphragm through which the ascending cava passes, corresponds to the upper part of the xyphoid cartilage: it is on a line with the cartilage and lower margin of the fifth ribs in front, and with the body of the ninth dorsal vertebra posteriorly.

The heart is retained *in situ* by the pericardium, by the two layers of pleura which constitute the mediastinum, and by the great vessels which convey the blood to and from it; above, the aorta and pulmonary artery proceed from the base of the ventricles; posteriorly, upon each side of the left auricle, the pulmonary veins open into it; on the right side posteriorly the ascending and descending venæ cavæ open into the right auricle; the former vein, as I have said, being intimately united to the diaphragm.

The base of the heart, from its connection with the great vessels, is in a great measure fixed: the apex and body of the ventricular portion are free, but the motions of this part are limited by the pericardium. The whole organ is, however, liable to slight changes of position during inspiration or expiration, and in the erect or recumbent posture: during inspiration the heart descends slightly; during expiration it ascends slightly; in the recumbent posture the heart recedes from the parietes of the thorax; in the erect posture it approaches them. In diseased states of the lungs or pleura the heart may be displaced considerably: thus, when a large amount of fluid is effused into the pleura on one side, the heart will be pushed towards the opposite side: in emphysema of the lungs of long standing, the heart is protruded downwards; while in large abdominal tumors, in ascites, pregnancy, &c., it will be pushed upwards. In cases of large introthoracic tumors, the heart may be displaced either upwards, downwards, forwards, backwards, or laterally, according to the situation and size of the tumor, and the rapidity of its growth. These matters will, however, be fully considered when we come to describe the diseased states of the organ.

Chambers of the heart.—The chambers of the heart are four in number,—two auricles and two ventricles. The auricles are two musculo-membranous sacs, which occupy the upper and posterior part of the organ, forming its base, separated from one another by a thin musculo-membranous septum; the ventricles are two muscular cavities, which form the body and apex of the heart, separated from one another by a thick muscular septum. The auricle and ventricle upon each side communicate with one another by a large orifice, through which the blood can pass readily from the former into the latter cavity, but is prevented from returning by a valvular apparatus. The right auricle receives the venous blood from the system generally, from which it passes into the right ventricle, by which it is propelled through the lungs. The left auricle receives the arterialized blood from the lungs, from which it passes into the left ventricle, by which it is propelled through the system. The auricles and ventricles contract and dilate alternately, and a double circulation is thus constantly going on,—a lesser and a greater, or a pulmonic and systemic, and the blood traverses two circles in its course,—a greater and a lesser, which are continuous the one with the other.

The organs which belong to the greater or systemic circulation are the left ventricle, the aorta and its branches, the veins of the body, and the right auricle. The organs which belong to the lesser or pulmonic circulation are the right ventricle, the pulmonary artery and veins, and the left auricle. The greater or systemic circulation commences in the minute ramifications of the pulmonary veins, and terminates in the capillaries of the arteries of the body. The lesser or pulmonic circulation begins in the capillaries of the veins of the body, and ends in the ultimate ramifications of the pulmonary. Thus the blood which has served the purposes of nutrition is brought by the venæ cavæ to the right side of the heart, by which it is transmitted to the lungs, where it is submitted to the action of atmospheric air, and assumes the bright red colour of arterial blood. It is then returned by the pulmonary veins to the left side of the organ, to be again distributed throughout the system.

Mode of opening the heart.—In order to display the interior of the ventricles, and to permit of the examination of the valves, some care is required in opening the heart. The most simple and convenient method appears to me to be to commence the incision in the pulmonary artery, carrying it through this vessel into the right ventricle, cutting between the sigmoid valves, and continuing to the apex, keeping close to the septum. A transverse incision, meeting the other about its centre, may then be made in the walls of the right ventricle. the aorta being then separated from the pulmonary artery, a similar incision is to be made through it into the left ventricle, and continued to its apex, keeping close to the septum. This incision can then be continued on through the apex upon the posterior surface of the heart. To display the interior of the right auricle a crucial incision may be made upon its anterior aspect, while the left auricle may be opened upon its posterior aspect, between the orifices of the opposite pulmonary veins.

Right auricle.—The right auricle forms the right, the inferior, and a portion of the anterior surface of the base of the heart. Its anterior surface lies to the right of the sternum; its posterior surface rests upon the diaphragm. It consists, in general terms, of a sinus, and an auricular appendix. The sinus of the auricle receives the blood from the descending and ascending venæ cavæ; the auricular appendix, which lies behind the cartilage of the third right rib, its tip resting against the right side of the ascending portion of the arch of the aorta, pretty nearly on a line with the sigmoid valves of the pulmonary artery, has a rude resemblance to the ear of a dog, from which it received the name, which has come since to be applied to the entire chamber. It varies somewhat in size and shape in different subjects. Its margin is often notched or serrated, something like the edge of the comb of a cock (to which the earlier anatomists compared it.) This appearance is, however, usually better marked in the appendix of the left than the right auricle.

The capacity of the cavity of the right auricle exceeds that of the left (as first pointed out by Vesalius:) its parietes are also thinner. Between the orifice of the superior cava and the appendix in the auricle a thick fasciculus of muscular fibres projects upon the interior, from which smaller fasciculi come off at a right angle, and run parallel to one another towards the appendix. The latter have received the name of musculi pectinati, from their fancied resemblance to the teeth of a comb, the thick fasciculus before mentioned forming its back. This is more evident in hearts in which the walls of the auricle are hypertrophied. In the auricular appendix the adjoining fasciculi are connected together by transverse branches, which gives its interior a reticulated appearance. In the interstices of these fasciculi the parietes of the auricle, when put on the stretch, will be observed to be semi-transparent in some places, the pericardium and endocardium being at these points in contact, and alone forming its walls.

On its right side posteriorly the right auricle receives the blood from the descending or superior, and the ascending or inferior vena cava. The former returns the blood from the head and upper extremities, and opens into the superior and anterior part of the auricle; the latter, which is on a plane posterior to it, returns the blood from the abdomen and lower extremities, and opens into the lower and back part of the auricle, near the septum auricularum. The manner in which the two venæ cavæ communicate with the auricle is such that the blood from the superior cannot fall into the orifice of the inferior cava. The current of the superior cava is downwards and forwards towards the auriculo-ventricular orifice: the current of the inferior cava is backwards and to the left side, towards the septum of the auricles, and it enters the auricle nearly at a right angle with the rest of the vein, immediately above the Eustachian valve, which directs the current towards the fossa ovalis.

The left posterior wall of the auricle is formed by the septum auricularum, at the lower part of which, immediately above the orifice of the inferior cava, we see the remains of the foramen ovale, through which, during fœtal life, the blood passed from the right to the left auricle, particularly that conveyed by the ascending vena cava, which is directed towards this orifice by the Eustachian valve. It is by no means rare to find the foramen ovale only partially obliterated in hearts otherwise perfectly healthy, and in subjects who had never exhibited any symptom of morbus cœruleus. The opening is usually valvular, is seated at its upper part, and will frequently admit a probe or the handle of a scalpel. M. Bizot states that he found the foramen ovale in the same condition in which it is at birth, or only partially obliterated, in eighteen out of seventy-three male subjects, and in twenty-six out of eighty-two female.

Right auriculo-ventricular orifice.—Inferiorly the auricle is united to its corresponding ventricle, and here the orifice of communication between the auricle and the ventricle is seated. This, the right auriculo-ventricular orifice, has an elliptic shape, the long diameter from before backwards, as the heart lies in situ; it is larger than the corresponding orifice of the left side, and its margin, like that of the latter, consists of dense, white, fibrous or tendinous tissue. By the older anatomists this was termed the right tendon of the heart. "It is plainly," Bell observes, "the place of union between the auricle and the ventricle, which are in the fœtus (the chick, for example) distinct bags." The right auriculo-ventricular orifice is situated behind the sternum, pretty nearly on a line with the junction of the cartilages of the fourth ribs with that bone. Between the Eustachian valve and the auriculo-ventricular orifice, the opening of the coronary vein is situated, provided with a valve formed by a semilunar fold of the lining membrane, which partially closes its orifice, and prevents regurgitation into it.

Right ventricle.—The right or pulmonic ventricle forms the right anterior and inferior portion of the body of the heart. The greater part of it lies behind the sternum. On the left side of this bone it extends under the sternal extremity of the cartilages of the third, fourth, fifth, and sixth left ribs: on the right side of this bone a small portion of it extends under the cartilages of the fourth and fifth right ribs, close to the sternum. Its inferior margin is about on a line with the junction of the xyphoid cartilage and the sternum. The base of the right ventricle is connected to the auricle of the same side: its apex is a little above the apex of the heart: its anterior wall, which lies immediately under the sternum, is convex: its inferior wall, which rests upon the diaphragm, is flattened: its left or posterior wall is formed by the septum ventriculorum.

The parietes of the right ventricle are much thinner, its columnæ carneæ are smaller, and its cavity (as was first pointed out by Vesalius) is somewhat larger than that of the left ventricle: this has been supposed to depend upon its parietes being more yielding than those of the left, and from the blood accumulating in, and distending it after death; but accurate measurement has shown that its cavity exceeds the left in capacity. The right ventricle has not a regular or symmetrical shape—it is broader, but not so long as the left; the septum, which is convex towards its cavity, belongs more to the left than to the right ventricle: and, as Bell remarked, "the right ventricle seems to be wrapped round the left," while the latter alone forms the apex of the heart. The right ventricle ascends higher than the left; hence the orifice of the pulmonary artery is on a plane higher than that of the aorta.

The cavity of the right ventricle consists of two parts, as first particularly described by Lieutaud—viz. an *arterial* and an *auricular* portion separated from one another by a prominent bundle of muscular fibres, and by the largest division of the tricuspid valve. The arterial portion—the "*conus arteriosis*" of Wolff, the "*infundibulum*" of Cruveilhier—is very smooth upon its surface, leads towards the pulmonary artery and is prolonged upwards above the level of the rest of the ventricle; in it the current is established by the systole of the ventricle, which is continuous with that of the pulmonary artery. The auricular portion, on the other hand, is very irregular upon its surface, owing to numerous prominent bundles of muscular fibres (the carneæ columnæ) which exist here; it receives the blood directly from the right auricle, and into it there is a current through the auriculo-ventricular orifice until the closure of the tricuspid valve. Mr. Serle, in his account of the arrangement of the muscular fibres of the heart, describes the cavity of the right ventricle as consisting of three parts: an "auricular," a "pulmonary or ventricular," and an "apicial;" the pulmonary and apicial form the arterial portion of Lieutaud. "The pulmonary (according to him) is that formed by the fibres which arise from the root of the pulmonary artery at its entire circumference: the apicial channel is that which forms the channel of communication between the other two, and which extends to the apex."

The carneæ columnæ are very numerous in the auricular portion of the ventricle: many run from the apex towards the base, others cross them, leaving deep sulci between them; some of these fleshy columns are attached in their whole length, others only by their extremities, and others again only by one extremity, the opposite giving insertion to the chordæ tendineæ of the tricuspid valve: the latter, which are sometimes termed *musculi papillares*, are fewer in number than either of the other kinds.

At the base of the ventricle two orifices are situated: one (auriculo-ventricular orifice) communicates with the auricle on that side; the other is the orifice of the pulmonary artery: each is provided with a valvular apparatus. The auriculo-ventricular orifice is situated at the posterior and right side of the base of the ventricle; the pulmonary orifice is to the left side, immediately above the septum of the ventricles, on a plane anterior to, and three-quarters of an inch higher up, than the other.

Tricuspid valve.—The right auriculo-ventricular orifice is encircled by a valve, formed by a duplicature of the lining membrane, strengthened by fibrous tissue, which comes off from the margin of the orifice: the free extremity of this valve hangs down into the ventricle, where, by means of the chordæ tendineæ, it is connected to the carneæ columnæ, and so with the walls of the ventricle. This valve is termed tricuspid (three-pointed) by the older writers, triglochine (three-angled,) its free margin forming three principal divisions: the chordæ tendineæ are the tendons, the carneæ columnæ the muscles of this valve; the tendinous cords converge from the point where they are attached to the valve, and several of them are inserted into a single fleshy column: when the latter contract the tendinous cords are made tense; hence, as the fleshy columns contract during the ventricular systole, the valve is shortened, and prevented from being reversed.

Three principal divisions of the tricuspid valve are distinguished—an anterior, a right, and a posterior: the anterior division separates the auriculo-ventricular from the pulmonary orifice, and is supposed to prevent the blood from passing into the pulmonary artery during the dilatation of the ventricle; but (as was remarked by Senac long since) this can scarcely be necessary, because during the ventricular diastole the sigmoid valves close the arterial orifice; the second division of the valve lies to the right side; and the third, which constitutes the posterior division, lies behind. It would be more natural to consider this valve, like the mitral, as composed of two principal divisions: an anterior, which would include the anterior and right division, and a posterior, which would correspond to the posterior division: in describing the valve, however, it is convenient to consider it as composed of three curtains.

The anterior curtain is connected by its chordæ tendineæ principally with one large and long fleshy column, which has two roots: one of these roots springs from the anterior wall of the ventricle; the other, which runs transversely, is attached to the septum of the ventricles: this is the portion which Mr. W. King terms the "long moderator band" The right curtain is connected by its fleshy columns to the parietes of the ventricle, not to the septum: two fleshy columns are attached in front; the others, which are much shorter, are attached to the posterior wall of the ventricle. The fleshy columns of the posterior division of the valve are much shorter than those of either of the others, and some of its tendinous cords are inserted without the intervention of any fleshy columns: they are all inserted into the septum.

A single slender tendinous cord, not proceeding from any fleshy column (which, however, is absent in some hearts,) is attached by one extremity to the *anterior* division of this valve, sometimes near where the chordæ tendineæ join the fleshy column, more frequently to the fleshy column itself, either near its base or apex, from which it runs towards the right wall of the ventricle, into which it is inserted, or to the base of the fleshy columns of one of the other divisions of the valve. The action of this tendinous cord will be to prevent the anterior curtain of the valve from being applied to the orifice when the ventricle is much distended; and from its insertion into the yielding wall of the ventricle, the more the ventricular cavity is distended the more open will it keep this curtain of the valve; while when the ventricle is not over-distended it will not interfere with the perfect action of the valve.

Pulmonary orifice.—The orifice of the pulmonary artery is situated on a plane about three-quarters of an inch higher than the auriculo-ventricular orifice, to its left side and more anteriorly; the surface of the ventricle from which it arises, and below this point, is perfectly smooth. The pulmonary orifice lies pretty nearly on a line with the junction of the cartilages of the third ribs with the sternum, very little to the left of this bone; it has a circular shape, is smaller than the auriculo-ventricular orifice, and is provided with a valvular apparatus at the point where the artery joins the ventricle, formed of folds of the lining membrane, strengthened by fibrous tissue.

Sigmoid valves.—The valves at the orifice of the pulmonary artery are three in number; they are analagous to the valves at the orifice of the aorta, but are thinner and more delicate. Morgagni gave them the name *sigmoid*, while those at the aortic orifice he named *semilunar:* these terms are, however, nearly indiscriminately used. The sigmoid valves have a crescentic shape as they lie against the walls of the artery: they are attached at the point where the pulmonary artery joins the ventricle, and this point or their base corresponds to a line across the inferior margin of the cartilage of the third ribs. One of these valves is anterior, another posterior or to the left side, and the third to the right side; each is attached by its convex margin, the concave or free margin being loose: their edges are a little thicker than the other parts, and in the centre of each near the margin a very minute nodule is seated, though in some instances scarcely a trace of it is to be found.

The sigmoid valves, when the blood is passing out of the ventricle, lie against the walls of the pulmonary artery and present no impediment to its passage; when the ventricle ceases to contract, the blood in the artery above gets behind them, they fall down, close the orifice, and prevent regurgitation into the ventricle.

Sinuses of the pulmonary artery.—Behind each sigmoid valve is a little pouch or sinus, where the coats of the vessel appear to be thinner: these are the sinuses of the pulmonary artery; their use evidently is to enable the blood to insinuate itself behind the valves when the ventricular systole ceases, by which they are pressed down, the orifice closed, and regurgitation into the ventricle prevented. These sinuses also allow a space for the sigmoid valves to lie back in during the ventricular systole, by which the outlet of the artery is rendered perfectly smooth and even, as the blood is passing from the ventricle into the pulmonary artery.

Description of the heart. continued—Left chambers of the organ—Left auricle—Left auriculo-ventricular orifice—Left ventricle—Mitral valve—Aortic orifice—Semilunar valves—Corpora Arantii—Sinuses of Morgagni—Muscular tissue of the heart—Nerves and blood-vessels of the heart—Endocardium.

LEFT CHAMBERS OF THE HEART.

Left auricle.—The left auricle occupies the upper, the posterior, and the left side of the base of the heart; it has an irregular square form, the transverse exceeding the vertical diameter; its parietes are thicker, and its cavity is smaller than that of the right auricle; its interior is smooth; the muscular fibres in it do not leave inter-spaces between them, and musculi pectinati are fewer. It consists, like the right, of a sinus, and an auricular appendix; the former receives the blood from the four pulmonary veins, and forms its principal bulk; it occupies the posterior part of the base of the heart, facing the bodies of the dorsal vertebræ, so that no part of it is visible when the pericardium is laid open. The auricular appendix (which is longer and narrower than that of the right side, and has its edge in general more deeply notched, or serrated,) is situated at the lower and left side of the auricle, below the orifices of the left pulmonary veins; it comes forward at the left side of the base of the ventricle, where it lies to the left of the root of the pulmonary artery, and eventually a little in front of it; it is the only part of the left auricle which is visible when the pericardium is laid open, and will be found immediately under the cartilage of the third left rib. At the point where the auricular appendix joins the sinus of the auricle, there is a narrowing or contraction of the diameter of the cavity: this is sometimes termed one of the orifices of the auricle, but incorrectly, because the sinus and appendix form but a single cavity.

In the interior of the left orifice five orifices are seen; the largest is the auriculo-ventricular orifice, the other four belong to the pulmonary veins; the latter open, one immediately above the other, at each side of the sinus, the two right at its posterior and right side, the two left at its posterior and left side. The two upper orifices are larger than the lower, and sometimes the two pulmonary veins of the left side open by a common orifice, sometimes there are three veins on the right side. The right wall of the oracle is formed by the septum auricularum; this, which is sometimes described as the base of the auricle, is convex towards the left side; in it we observe the depression which marks the sight of the foramen ovale.

Left auriculo-ventricular orifice.—This orifice, which forms the communication between the auricle and ventricle, is situated in the floor of the auricle; it has an elliptic, or more correctly, a crescentic shape, the long diameter being nearly transversely; it is smaller than the corresponding orifice of the right side; its margin is smooth, and consists of dense, white, fibrous, or tendinous tissue. The left auriculo-ventricular orifice is on a plane posterior to and to the left side of the tricuspid orifice, but nearly on the same level, as the heart lies in situ: it is situated behind the sternum, and upon a line with the junction of the cartilage of the fourth rib with that bone.

Left ventricle.—The left, the aortic, or systemic ventricle, forms the left and posterior part of the body of the heart; it has a conical form, the base above where it joins the auricle, the apex below where it forms exclusively the apex of the heart; its parietes are convex externally, and concave internally, equally upon the side of the septum, as in its left and posterior wall, so that the septum seems to project into the cavity of the right ventricle. The walls of the left ventricle are strong, thick, and muscular, about three times the diameter of those of the right ventricle, as was first pointed out by Riolanus; they preserve, consequently, their convex form after the cavity of the ventricle is emptied, while the parietes of the right ventricle collapse under similar circumstances. The left ventricle is longer than the right, but its cavity is smaller, and its carneæ columnæ are much thicker and stronger.

A small portion only of the left ventricle is seen when the pericardium is laid open; this is to the left of the sternum, extending from the cartilage of the third left rib, to the interspace between the fifth and sixth left ribs, near where the cartilage joins the body of these ribs. The appendix of the left auricle, which comes forward directly beneath the cartilage of the third left rib, surmounts the left ventricle here.

In the cavity of the left ventricle, as in that of the right, two parts are distinguished, an arterial and an auricular portion, separated from one another by the right or anterior division of the mitral valve. The former is the smooth surface leading to the aortic orifice; it is smaller than the corresponding portion of the right ventricle, and is bounded on the right side by the upper part of the septum of the ventricles, and posteriorly by the anterior or right curtain of the mitral valve. The auricular portion forms the larger part of the ventricular cavity: it communicates directly with the auricle on the same side.

The auriculo-ventricular and the arterial orifices lie much nearer each other on the left than on the right side of the heart, being only separated by the right or anterior curtain of the mitral valve. The aortic orifice is on a plane above, anterior to, and to the right of the auriculo-ventricular orifice: the right or anterior division of the mitral valve which separates them is supposed to prevent the blood from entering the aorta while the ventricle is filling; but as the semilunar valves are closed at this period, it can scarcely have this use.

Mitral valve.—From the margin of the tendinous ring which surrounds the left auriculo-ventricular orifice, a valve composed of a double fold of the lining membrane, enclosing tendinous fibres, proceeds, the free surface of which hangs down into the ventricle; this valve is analogous in office to that of the right side, but is larger and stronger in all its parts: its chordæ tendineæ are stronger, and its carneæ are stronger, and its carneæ columnæ are thicker.

This valve has more strictly two divisions than the tricuspid, and is properly termed *bicuspid* from this circumstance: one of these is anterior, the other posterior; the former being more to the right side is sometimes termed the right division, the latter the left. Vesalius compared this valve to a bishop's mitre, "quas mitræ episcopali non admodum inepte contuleris," and the name *mitral* has been almost invariably applied to the valve since.

The anterior or right division of the mitral valve is the larger; it ascends higher than the other, reaching to the base of the posterior and right semilunar valves of the aorta: its curtain forms in a great measure the septum between the aortic and the auriculo-ventricular orifices, so that when we remove it the two orifices seem almost to constitute but one; indeed, it was formerly termed the valvular septum of Lieutaud from this circumstance. The carneæ columnæ of the mitral valve are all attached to the posterior wall of the ventricle: those of the anterior curtain arise from opposite sides of the posterior wall, each by two strong columns: the tendinous cords connected with them run towards one another, so that if continued along the curtain of the valve they would cross each other. The carneæ columnæ of the posterior division of this valve are three in number; they are shorter, broader, and less cylindrical than the fleshy columns of the anterior division. The strength of the chordæ tendineæ of this valve, notwithstanding their tenuity, is very remarkable: Senac tested it by isolating a single one, and attaching to it a four pound weight, which it supported for some time.

Aortic orifice.—The aortic orifice, like the pulmonary, has a circular shape; it is situated at the upper and right corner of the base of the ventricle, behind the orifice of the pulmonary artery, and on a plane lower down. It lies anterior to, higher up, and to the right side of the auriculo-ventricular orifice, but very close to it; these two orifices being merely separated, as I have said, by the right or anterior curtain of the mitral valve.

Semilunar valves.—The aortic orifice is provided with three valves, named semilunar by Morgagni, which are attached by their convex margin at the point where the aorta and left ventricle become continous; their concave or free margin looks upwards. One of these valves is anterior, another posterior, and the third inferior: they are situated behind the sternum, towards the left side of this bone on a line with the space between the cartilages of the third and fourth ribs; their free edge corresponds (M. Gendrin observes) to the base of the pulmonary valves; a line drawn across the inferior margin of the third rib corresponds to the free border of the aortic valves, and to the base of the valves of the pulmonary artery.

The semilunar valves of the aorta resemble the valves of the pulmonary artery in almost every respect; but are thicker and stronger. They consist of duplicatures of the lining membrane, strengthened by tendinous bands; of these bands; one runs along the free margin of each valve, another along its base, and another, which is broader, runs upon each side of the corpus Arantii, and takes a semicircular course from this body to the attached margin of the valve. These tendinous bands have been recently described by M. Monneret as muscles: the action of one set of fibres (according to him) is to raise the valve, the other set are antagonists, and serve to depress them. But as the semilunar valves are elevated and depressed mechanically by the flux and reflux of the blood, it is not easy to perceive, Magendie observes, what purpose muscles placed between the membranous folds of these valves could serve.

Corpora Arantii.—Near the centre of the margin of the free edge of each valve a little fibro-cartilaginous body is seated; these are usually termed "corpora Arantii, after Arantius, a pupil of Vesalius, who first accurately described them, though they had been noticed previously by Vidus Vidus; sometimes they are termed "corpora sesamoidea," or "noduli Morgagni." These little bodies are more distinct and larger in the semilunar valves of the aorta than in those of the pulmonary artery; their use is said to be to strengthen the central point where the valves meet, where the pressure is considerable, and the resistance least; as well as to fill up the little space which would be left in the centre when the valves fall down: but as these little bodies are not seated at the very margin of the valves, they could hardly effect the latter object, which, indeed, is unnecessary, as it has been shown that these valves slightly overlap one another in the healthy subject. The use of the corpora Arantii appears to me to be to serve as points of attachment for the tendinous bands already mentioned, by which the valves are strengthened; without some provision of this kind these valves would much more frequently become reversed and permit regurgitation than they do.

Sinuses of Morgagni.—Behind each semilunar valve the parietes of the artery are dilated, and a little pouch or sinus is formed, where the parietes of the artery are thinner than in other parts; these are the sinuses of Morgagni, or the lesser sinuses of the heart. They are better developed in the aorta than in the pulmonary artery, and in old age than in young subjects. In these sinuses the orifices of the two coronary arteries are seen, and Dr. Chevers distinguishes those from which the right and left coronary arteries arise, by the names *right* and *left;* the third he calls the *intermediate* sinus. The disposition of the fibres of the sclerous coat of the aorta in these sinuses, by which the parieties are strengthened, and the attachment of the valve secured, has been well described by him. The use of these sinuses is similar to that of the same parts at the origin of the pulmonary artery; they allow a space for the blood to insinuate itself behind the valves when the ventricular systole ceases, by which they are pressed down and the orifice closed; and they afford a space for the semilunar valves to lie back in during the systole of the ventricle, by which the channel along which the blood passes is rendered perfectly smooth.

The aorta is connected to the left ventricle by the endocardium within, and by the serous and fibrous layers of the pericardium externally, which are continuous with one another in the heart and artery. When these are removed the junction of the fibrous membrane of the artery with the muscular tissue of the heart is seen to be by three crescentic prolongations or festoons, each of which has its convex margin towards the ventricle, and between each is a small triangular interval, the base of which corresponds to the base of the ventricle.

The place where the aorta joins the ventricle is marked by a tendinous ring (*zona tendinosa:*)

the semilunar valves of the aorta are situated at this part, the convex margin of each being attached opposite to the convex margin of the crescentic prolongation above described, and each receiving tendinous fibres from this ring.

Muscular tissue of the heart.—The muscular tissue which forms the principal bulk of the heart is situated between the endocardium on the one hand, and the pericardium on the other, and differs from the muscles of animal life in several respects; the latter are connected together by cellular tissue, and with the naked eye are seen to consist of bundles of fibres, which the former interlace and cross in different directions: under the microscope, also other differences are observed,—as the granular appearance of the fibres, and the less distinctness of the transverse striæ. The substance of the heart contains a larger amount of muscular fibre for its size than any other part, and its tissue is compact, firm, and close; for this reason the heart of animals, when cooked, cuts uniformly smooth in every direction, and "eats short, not offering that elastic resistance which other muscles do during mastication."

The use of the cellular tissue which connects together the fibres of the muscles of animal life, and which forms their sheaths, appears to be in a great measure to retain the muscular fibres within their proper sphere of action, and to strengthen them. In the heart, cellular tissue was supposed to be less necessary, in consequence of the manner in which the muscular fibres themselves are arranged; but Dr. Robert Lee* has recently shown that the heart is provided with a fascia which binds together and gives support to the muscular fibres in the same way as the fascia which invests the muscles of animal life. This, which he terms the "*cardiac fascia*," lies immediately under the true serous coat, and, after investing every part of the auricles and ventricles, it sends prolongations from its under surface, which surround the bloodvessels and nerves, forming sheaths for them, and accompanying their branches between the muscular fasciculi through the entire walls of the heart, from the surface, to the lining membrane, investing and binding all the parts together in the strongest possible manner, and giving firmness and strength to the organ.

A vast deal of pains, time, and labour, have been expended by anatomists in endeavouring to unravel the course of the muscular fibres of the heart; in many instances "they have succeeded (it has been observed) only in giving unintelligible descriptions." Recently Mr. Searle has undertaken the task: his account of the arrangement of the muscular fibres of the heart is contained in the Cyclopædia of Anatomy and Physiology; his description would, however, be utterly unintelligible without the figures with which his paper is illustrated; and, even with the assistance of these, the peculiar manner in which the bands, fasciculi, and layers, which enter into the formation of the heart, are arranged, could scarcely be understood without quoting his description at length.

It will be sufficient here to observe that each ventricle has its own distinct sets of fibres, which form its sac, that another set of fibres surrounds, encloses, and unites together the two ventricles; that in the left ventricle six layers of fibres have been distinguished, in the right but three, which are arranged into a superficial, a middle, and an internal set; that the fibres are disposed in a spiral direction, "some winding round and round the ventricle," "some taking a larger sweep, and surrounding both ventricles;" that they interlace with one another, and that some are continuous with the carneæ columnæ in the interior of the ventricle.

The septum is described by Mr. Searle as consisting of three layers—a left, a middle, and a right; the two former belong properly to the left ventricle; the right layer exclusively to the right ventricle.

In the auricles the fibres are disposed in two layers: its fibres "arise chiefly from the tendinous margins of the annulus venosus and annulus arteriosus." The peculiar shape of the appendices depends upon the manner in which the fibres are arranged, as also the appearance known under the name of the musculi pectinati. The fibres of the right auricle are prolonged so as to form the outer part of the wall of the left auricle, which, as it receives additional bands of fibres, is necessarily thicker than the right auricle. The septum of the auricles receives fibres from three sources—superiorly, in its middle, and inferiorly.

The cause of the conical form of the ventricular portion of the heart is explained by Mr. Searle as follows:—"Along the central cavity of the left ventricle are placed the two carneæ columnæ, the length of which is equal to the lower three-fourths of the length of the axis of this cavity. The fibres of these two bodies radiate, and the radiated fibres wind round the axis closely upon them. By this radiation, instead of all the fibres passing longitudinally, which would have preserved these bodies in a state of equal thickness throughout their length, they are progressively parting with their fibres, retaining but a few, which, by their longitudinal course, reach the apex; consequently these columns gradually diminish, becoming pyramidal, and form together an inverted cone; and as the fibres in well-formed hearts wind closely round these columns, the entire ventricle gently assumes the form of a cone; and although the right ventricle is, as it were, appended to the left, yet it is not so connected to it as to destroy the conical form, but, on the contrary, in such a manner as to form a concave parabolic section of a cone, which adapts itself to the gentle cone of the left ventricle. The two ventricles thus united assume the form of the more rapid cone of the heart."

Nerves of the heart.—The heart receives its nerves from both the ganglionic and cerebro-spinal system; the former are derived from the three cervical ganglions of the great sympathetic, and sometimes from the first dorsal ganglion; the latter are derived from the par vagum or pneumogastric nerve, and from its branch, the recurrent or inferior laryngeal nerve.

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* Philosophical Transactions, 1849.

The three cardiac nerves upon each side, which are termed respectively the superior, the middle, and the inferior, come from the superior, the middle, and the inferior cervical ganglia of the great sympathetic. The superior cardiac nerve communicates with the middle and with the pneumogastric nerve; the middle communicates with both the superior and inferior, as well as with the pneumogastric and recurrent;' the inferior communicates with the middle and with the recurrent nerves.

The cardiac ganglion receives the superior cardiac nerves on each side, and a branch from the pneumo-gastric, and sends branches to the cardiac plexuses. The great cardiac plexus is formed by the middle and inferior cardiac nerves from opposite sides; it receives branches also from the pneumo-gastric and recurrent: it lies behind the ascending portion of the arch of the aorta, in front of the trachea, near its bifurcation. From it, lesser plexuses are formed, termed the anterior and posterior cardiac or coronary plexuses, which accompany the coronary vessels, supply the substance of the heart, and communicate with the pulmonary plexuses.

The experiments of Volkman go to prove that the movements of the heart are independent both of the brain and spinal cord, and that its movements "depend upon the ganglia and the nerve fibres contained within itself; whilst centripetal fibres of these ganglia are found in the vagus, sympathetic, and in the spinal cord." It is to Dr. Robert Lee, however, that we are principally indebted for our knowledge of the ganglia and plexuses of the heart,—a subject which he has investigated with a patience and skill deserving of every praise. He has shown* that every artery distributed throughout the walls of the heart, and every muscular fasciculus, is supplied with nerves, upon which ganglia are formed. The number of these ganglia may be estimated by the fact that as many as ninety are visible upon the nerves on the anterior surface of the heart.

The following conclusions, under this head, are given by Dr. Lee:—

1. That the blood-vessels, and the muscular structure of the auricles and ventricles of the heart, are endowed with numerous ganglia and plexuses of nerves, which have not hitherto been described, or represented in the works of anatomists.

2. That the nervous structure of the heart, which are distributed over its surface, to the apex and throughout its walls, to the lining membrane and columnæ carnæ, enlarge with the natural growth of the heart before birth, during childhood and youth, until the heart has attained its full size in the adult.

3. That the ganglia and nerves of the heart enlarge like those of the gravid uterus when the walls of the ventricles are affected with hypertrophy.

4. That the ganglia and nerves which supply the left auricle and ventricle in the natural state are more than double the size of the ganglia and and nerves distributed to the right side of the heart.

Blood-vessels of the heart.—The heart, although always more or less full of blood, cannot appropriate any of the fluid which passes through its cavities to its own nutrition; but like every other organ, has peculiar vessels set apart to supply it: these are the two coronary arteries, which come off at the sinuses of Morgagni. The principal division of the anterior or left coronary artery lies in the anterior longitudinal groove. The posterior or right coronary artery is lodged in the circular or auriculo-ventricular groove, and a large branch of it runs down the posterior longitudinal groove. These vessels inosculate freely with one another, and the grooves in which they run mark the site of the septum of the ventricles, as well as the line of separation between the auricles and ventricles.

The veins of the heart accompany the arteries, and end in a single trunk, which opens in the right auricle, between the Eustachian valve and the right auriculo-ventricular orifice. A valve, formed by a semilunar fold of the lining membrane of the heart, partially closes the orifice here, and prevents regurgitation into it.

Endocardium.—The interior of the cavities of the heart is lined throughout by a very fine transparent and delicate membrane, named by M. Bouillaud, the "endocardium," which is to the internal surface of the heart what the serous layer of the pericardium is to its external surface. This membrane is very smooth, highly polished, and analogous in almost every respect to serous membrane: it is continuous with the lining membrane of the large vessels, both arteries and veins, which open into the heart, as well as with the arteries and veins of the heart itself; it lines every part of the interior of the cavities, of both the auricles and ventricles, covers the chordæ tendinæ and carneæ columnæ, and is reflected upon itself at the arterial and auriculo-ventricular orifices, to assist in forming the valves.

The endocardium is connected to the tendinous and muscular structures underneath by means of very fine cellular tissue, to which it is so adherent that it can only be detached by the scalpel in small patches. The adhesion is closer about the valves than at any other part, owing to certain fibrous expansions, which, proceeding from the orifice, are continued under the endocardium upon the curtains of the valves, particularly upon the left side, as well as towards the auricular and ventricular cavities.

The endocardium, in the right auricle and right ventricle, is continuous with the lining membrane of the venæ cavæ, and thus with the venous system throughout the body. The endocardium in the left auricle and left ventricle is continuous with the lining membrane of the aorta, and thus with the arterial system throughout the body. This helps to explain why morbid changes are so much more frequent in the left cavities of the heart han in the right; as arterial tissue is well known o be very subject to disease, while the coats or veins are comparatively exempt.

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* Philosophical Transactions, 1849.

According to M. Bouillaud, the endocardium is somewhat more delicate and fine in the right cavities of the heart than in the left, and in the ventricles than in the auricles; and it is thickest about the arterial and auriculo-ventricular orifices. According to M. Bizot,* this membrane in early life has the same transparency, thickness and consistence, in every part of the interior of the heart. Subsequently, a slight opacity begins to make its appearance in the vicinity of the semilunar valves of the aorta, and gradually increases, but is always most marked at the point at which it was first observed. As the membrane becomes opaque it appears also to become slightly thickened; but this is not due to the presence of a false membrane. It is a simple opacity, and appears to be analagous to the white patch upon the visceral layer of the pericardium. This appearance is only observed upon the left side of the heart. M. Bizot has has never found it upon the right side; and age appears to have a marked influence upon its development; for it is very rare under puberty, and very frequent in old age.

The following table given by M. Bizot shows the comparative frequency of this opacity of the endocardium in the two sexes, and at different ages:—

	Male.		Female.	
Age.	Number of subjects.	No. of examples.	No. of subjects.	No. of examples.
1 to 15	11	1	23	1
16 „ 39	26	9	30	10
40 „ 59	18	6	15	10
60 „ 78	10	8	12	10

The important place which the endocardium occupies is shown by its being (as M. Bouillaud observes†) the *point de départ* of the most frequent and most serious lesions of the valves and orifices of the heart. Like the pericardium, it is liable to inflammation, but this is usually limited to the portion of the membrane which covers the valves or lines the orifices; and is, in a great measure, confined to the left side of the organ. The changes produced by disease in the valves and orifices of the heart will be considered under the head of Valvular Disease.

The pericardium—Fibrous layer of—Serous layer of—Cardiac fascia—White patches on visceral layer of pericardium—Seat of—Nature and causes of—Conclusions respecting—Dimensions of the heart—Normal size of the organ—Length of the heart—Breadth of the heart—Conclusions respecting the size of the heart—Weight of the healthy heart. Absolute weight of the organ. Ratio of the weight of the heart to the entire body. Comparative weight of different parts of the heart to each other. Conclusions respecting the weight of the heart.

The pericardium.—The pericardium belongs to the class of fibro-serous membranes, and consists of two layers, an external fibrous and internal serous. The fibrous layer is strong and resisting, though having but little thickness: it forms what is called the sac of the pericardium, and encloses the heart and the origin of the large vessels which come off from its base. The serous layer is thin and delicate in comparison: it closely invests the heart, covers the origin of the large vessels, and is then reflected upon the internal surface of the fibrous layer, which it lines throughout. Thus, as is the case with other serous membranes, the heart, although invested by the pericardium, is not contained in its cavity.

The pericardial sac has a pyriform shape, the base below, the apex above; exactly the reverse of that of the heart. Its base is on a line with the upper part of the xyphoid cartilage; its apex a short distance above the origin of the large vessels, and generally on a line with the articulation of the cartilage of the second ribs with the sternum. I have, however, found it to extend, in a healthy subject, as high as the level of the articulation of the first ribs with the sternum. Its apex is higher upon each side of the aorta than immediately opposite to that vessel. The pericardial sac is wider in the centre than at its base, and here it extends more to the left side. Its widest part is on a line with the greatest transverse diameter of the heart.

Capacity of the pericardium.—The capacity of the pericardial sac is somewhat greater than the volume of the heart; and, as its cavities are never all distended at the same moment, there is always abundant room for the apex and body of the organ to move freely in it. For the same reason, effusion of fluid to a moderate extent may take place into the cavity of the pericardium without interfering much with the heart's movements, provided it is effused slowly and gradually. On the other hand, even a moderate amount of fluid suddenly effused will be attended with formidable symptoms, because the fibrous nature of this membrane does not permit of its yielding suddenly. In chronic cases of disease, however, the pericardial sac is capable of becoming enormously dilated, as we shall afterwards see.

The actual capacity of the pericardium has been endeavoured to be determined by injecting fluid into and forcibly distending its sac. Dr. Sibson, in a recent number of the London Journal of Medicine, has given the following table of the results of some experiments made by him:—

Boy æt. 6, pericardium injected to distention, held	6 oz.
" 9,	6 oz.
" 13, about	6 oz.
Adult male	15 oz.
Male aged 50	22 oz.
Adult female (heart enlarged)	26 oz.

"From these and other observations, (Dr.

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* Mem. de la Soc. Med. d'Observation, tome i.

† Traité des Maladies du Cœur, 2nd edition.

Sibson says) it may be inferred that in the adult, when the heart is healthy, the pericardium, when fully distended, can contain from twelve to fifteen ounces of fluid." "It is worthy of remark (he adds) that the right cavities of the heart in the adult male, when distended, hold the same quantity of fluids as the pericardium.

Fibrous layer of pericardium.—The fibrous layer of the pericardium is dense and strong, and is composed of tendinous fibres, some of which run vertically from the base towards the apex, others cross each other in various directions. Its tissue is semi-transparent, permitting the heart to be seen through it. It is very intimately united inferiorly to the central tendinous aponeurosis of the diaphragm: the fibres of each (as Lancisi observed) mix, and are confounded with one another: so that the pericardium seems as if it were a prolongation of this aponeurosis. It is also connected with the fleshy portion of the diaphragm on the left side; but the adhesion here is less intimate. Superiorly the fibrous layer of the pericardium is closely united to the trunks of the large vessels which come off from the base of the heart. It gives them sheaths; and, after accompanying them for a short distance, it becomes continuous with the thoracic fascia. The inferior cava alone receives no fibrous sheath from it. Anteriorly a small portion of its surface is only separated from the sternum by cellular tissue. Laterally it is connected with the pleura on each side, the phrenic nerve on the left side being interposed. Posteriorly, the pericardium, which is of small extent compared with its anterior surface, lies in front of the posterior mediastinum, being separated from the bodies of the dorsal vertebræ by the œsophagus and descending aorta.

The fibrous layer of the pericardium does not form a complete capsule for the heart; it is deficient inferiorly, where it is replaced by the central tendinous aponeurosis of the diaphragm; the reflected serous layer, which is attached to this part of the diaphragm, forming its capsule here. Owing to its density and strength, the fibrous layer of the pericardium serves both to support and to limit the motion of the heart; while it retains it in situ. From its firm attachments above, below, and laterally, if, as not unfrequently happens from disease, the opposed serous surfaces become adherent to one another, the motions of the heart must be, in a certain degree, interfered with.

Serous layer of pericardium.—The serous layer of the pericardium which invests the heart is thin and delicate compared with the fibrous layer. It consists of two layers, a proper serous and a fibrous layer; the latter forms the capsule of the heart; the former, after covering the heart, ascends, for an inch and a half to two inches, upon the aorta, and upon the pulmonary artery as high as its bifurcation, where it is reflected upon internal surface of the pericardial sac. Hence the greater portion of the ascending part of the arch of the aorta is said to be within the sac of the pericardium; and hence aneurism of this part of the vessel occasionally bursts into it. Where the serous layer lines the sac of the pericardium it is very intimately adherent to it; where it covers the origin of the large vessels it is much less so. Inferiorly, where the fibrous portion of the pericardial sac is deficient, the serous layer lines the central apouneurosis of the diaphragm.

Cardiac fascia.—The serous layer of the pericardium, which invests the heart, was always described as a single membranous layer, until Dr. Robert Lee* demonstrated two layers in it, which are connected together by cellular tissue. The outermost of these layers is the proper serous coat; the inner layer, from its structure and function, and from the important office which it performs, Dr. Lee considers may be regarded as the fibrous membrane or fascia of the heart.

This expansion "is possessed of great strength and firmness. It is glistening, semitransparent, and resembles in all respects the aponeurotic expansions, or fasciæ covering muscles, in other parts of the body." "It is much stronger over the ventricles than the auricles, and it adheres so firmly to the muscular substance underneath that its separation cannot be effected without tearing up some of the muscular fibres to which it is attached." "From the inner surface of this fascia innumerable strong fibres pass to the blood-vessels, nerves, muscular fasciculi, and adipose matter, which accompany and surround all the blood-vessels and nerves; and they are interlaced together so as to form a peculiar stroma, if it may be so termed, of considerable thickness, between the fascia and all the various structures beneath, which it invests and binds together in the strongest possible manner. These fibres form a complete sheath around all the arteries, veins, and nerves, on the surface of the heart, and accompany them as they dip down between the muscular fasciculi, to which their branches are distributed throughout the entire walls of the heart, from its surface to the lining membrane."

"The cardiac fascia," Dr. Lee observes, "is obviously one of the principal causes of the firmness and strength of the central organ of the circulation, as it binds together into one mass, and gives support to the muscular fibres, like the fascia which invests other muscles." "The cardiac fascia is to the heart, I believe, what the external fibrous coat is to an artery; and it must have nearly the same effect in preventing dilatation and rupture of the ventricle during violent exertion." "The feeble serous covering of the heart can possess little influence, and add nothing to the strength of the parietes; and probably, but for the fascia now described, the heart would often yield in all directions, especially at the apex. In a physiological point of view, it therefore has appeared to me that this fascia of the heart is one of its most important strictures."

"In a pathological point of view," Dr. Lee observes, "the cardiac fascia is perhaps not less worthy of notice. Muscular structure, it is well known, is not liable to attacks either of common

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Philosophical Transactions. 1848.

or of specific inflammation. It is impossible to avoid suspecting that rheumatic inflammation of the heart has for its principal seat this dense fibrous membrane lying between the serous and muscular coats of the heart, and that attacks of rheumatism of the heart do not commence primarily in the muscular structure."

The opposed serous surface of the pericardium are very smooth, and constantly lubricated: hence in the normal condition of the parts they glide over one another during the motions of the heart without producing sound. If, however, as is not unfrequently the result of disease, these surfaces become rough or uneven, increased friction must take place between them during the heart's motions, and sounds will be developed which become audible when the ear or the stethoscope is applied to the parietes. These constitute the pericarditic friction sounds, afterwards to be considered.

Owing to the intimate connection of the pericardium inferiorly with the diaphragm, it must follow the movements of the latter; and from its attachments above and below, its shape and state of tension must be somewhat different during inspiration and expiration; while if much fluid be effused into its sac, not only will the movements of the heart, the ascent of the diaphragm, and the expansion of the lungs, be more or less interfered with, but the lungs will be pushed aside, a larger surface of the pericardium will come in contact with the parietes of the chest in front, and the region of the heart's superficial dulness on percussion will be increased in proportion. The effect of the forcible distension of the pericardium, in Dr. Sibson's experiments, was to make the central tendinous aponeurosis of the diaphragm convex towards the abdomen, and to lower this part about one inch.

White patches on pericardium.—Nothing is more common than to find upon the serous layer of the pericardium, where it invests the anterior surface of the heart, a white patch, of variable size and shape: indeed, it is so frequent, and it is so often found in hearts which in other respects are perfectly healthy, that it has been regarded by some as a natural appearance.

The anterior surface of the right ventricle is its most frequent seat: occasionally it is observed upon the surface of the left ventricle, or upon both ventricles, and occasionally upon the auricles. Frequently only one exists, sometimes several are seen upon the same heart; they have an opaque white colour; the shape is very variable; it is often somewhat circular or oval, occasionally more or less linear, and extending in the line of the coronary vessels. The size of these patches varies from a fourpenny piece to a crown, or even larger: when one only is present, it is usually larger than when several occur upon the same heart. They are much more common in the adult than in early life, but have been observed in the infant under three months; they are larger and better marked in advanced life, and they are much more common upon the male than the female heart.

Seat of the white patches.—Some difference of opinion exists among pathologists as to the exact seat of these opaque patches, some placing it upon the free surface of the pericardium, others upon its under surface, and others in the proper tissue of the membrane. Thus Baillie, Laennec, Louis, and Todd,* state that these opaque patches can easily be dissected or peeled off from the visceral layer of the pericardium, leaving this membrane entire. Corvisart, on the other hand, says, that these patches are seated upon the under surface of the membrane, and that they cannot be dissected off without bringing the pericardium with it. Dr. Hodgkin says, he has met with a few instances where they might be dissected off; but in by far the greater number of cases these patches depend on a deposit on the attached surfaces. Mr. T. W. King considers the actual seat of the deposit to be the proper tissue of the serous membrane. Mr. Paget† says, these patches are "generally easily stripped off; but in no case after they are organized can they be separated from the subjacent tissue without dividing numerous connecting filaments, and leaving the surface from which they are removed flocculent and shreddy."

Nature and causes of.—A similar diversity of opinion exists among pathologists respecting the nature and cause of these opaque patches. By some they are referred to inflammation, and supposed to be always the result of partial pericarditis. Mr. Paget, who advocates this view exclusively, observes, "with these spots there almost constantly coincides some adhesion by organized lymph between adjacent parts of the pericardial membrane." "The adhesions generally consist of slender threads passing across the furrow between the aorta and vena cava superior, or between the aorta and pulmonary artery at some little distance from their connection with the heart." In 40 cases noted by Mr. Paget, in which white patches were found upon the heart, 35 presented abnormal adhesions, or their remains.

If these opaque patches were always the result of inflammation, pericarditis, in a latent form, must evidently be a much more frequent disease than is commonly supposed; but as in the majority of cases the serous membrane at the part preserves its smooth and glistening appearance, the opacity can hardly be due to lymph deposited upon it; besides, adhesions between the visceral and the reflected layers of the pericardium, instead of being very rare in connection with these patches, ought to be frequent, if they were always the result of the deposition of lymph.

Other pathologists regard these opaque patches as the effect of attrition between the surface of the heart and parietes of the thorax; as they are found most frequently upon the anterior surface of the right ventricle. Dr. Hodgkin‡ is of opinion that pressure is the cause, and that they are the result of a kind of inflammation originating in attrition and irritation. Mr. T. W. King[*] says, "the situation of these patches wherever they occur, implies to my mind a degree of attrition at the part more than belongs to the pericardium generally," and he suggests the name "patches of attrition," or "patches of distention" for them. It militates, however, against this theory, that these white patches are not unfrequent upon parts of the heart where attrition cannot take place.

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* Cyclopædia of Anat. and Physiology.
† Med. Chir Trans. vol. xxiii.
‡ Lect on Morb. Anat. of Serous Membranes.

Other pathologists are of opinion that these patches are not to be regarded as a pathological phenomenon, because they are found in the most healthy hearts, and where the patient has never laboured under any affection referable to the heart; and because similar opaque patches are found upon other viscera which are covered by serous membrane; as the liver, intestines, &c.

M. Bizot, whose researches have tended to elucidate many doubtful points connected with the normal anatomy of the heart, has shown[†] that these white patches are of two descriptions, one a morbid secretion of two serous membranes, probably consecutive to inflammation; the other is not a product of inflammation, but appears to be in some way connected with the progress of age.

The first variety, which is the rarest, is found indifferently upon every portion of the pericardium covering the auricles and ventricles; it has its seat upon the free surface of the membrane, and can be detached without difficulty from the serous membrane underneath, which preserves its natural appearance.

The second variety is usually found upon the anterior surface of the right ventricle, and has its seat in the serous membrane itself, which undergoes a slow transformation, becomes slightly thicker in the centre, and gradually loses its transparency; if we try to detach the serous membrane at the part, the opaque patch is removed with it. This is the most frequent variety; M. Bizot states that in 156 subjects he found it 45 times; it is much more frequently met with in the male than in the female: in 72 males it occurred 31 times, in 84 females only 14 times. Mr. Paget's researches likewise show that these patches are more common in the male than the female.

The anterior surface of the right ventricle is the most frequent seat of this variety. In 45 instances, noted by M. Bizot, it occupied the centre of the anterior surface of the right ventricle in 20; in 18 it occupied also the anterior surface of the left ventricle; in 7 only it was found exclusively upon the left ventricle. The influence of age upon its development is also remarkable; it was not found in the male under 17 years of age, or in the female under 22. After 40 years of age, in both sexes, these patches were not only better marked, but larger.

The following table, given by M. Bizot, shows its frequency at different ages, and in the two sexes:—

MALE.			FEMALE.		
Age.	No. of subjects.	No of examples.	Age.	No. of subjects.	No. of examples.
1 to 17	16	0	1 to 22	31	0
18 " 39	24	8	23 " 39	23	5
40 " 79	32	23	40 " 89	30	9

Conclusions.—There can be no doubt that the opaque white patches which are found upon the visceral layer of the pericardium have not always the same origin. That they are sometimes the result of inflammation is more than probable, because several patches are occasionally present, and the opacity extends along the course of the coronary vessels on both sides of the heart, particularly along the veins; adhesions likewise will be found between the base of the auricular appendices and adjoining parts, or between the aorta and pulmonary artery, as described by Mr. Paget. In these cases a slighter degree of opacity or a haziness of the membrane will be observed in addition around the patches: they can be dissected off, but the surface from which they are detached is flocculent and uneven. The seat of the deposition of the lymph appears to be rather under the serous layer of the pericardium than upon its free surface, and may probably be upon the cardiac fascia described by Dr. Robert Lee.

The other variety, which is never seen in young subjects, appears to be the result of some peculiar alteration or degeneration of the transparent tissues connected with advanced life, and analogous to the *arcus senilis*: it probably commences in the serous layer of the pericardium itself; it is much more frequent than the other; its ordinary seat is upon the anterior surface of the right ventricle; and the older the subject, the more marked in general is the opacity.

Dimensions of the Heart.

Normal size of the heart.—In order to determine whether the heart is increased or diminished, or preserves its normal dimensions, it is absolutely necessary to have correct ideas respecting the size and weight of the heart; but as these vary with the age of the subject and with the sex of the individual, it is obvious that we can have no single standard for the adult heart.

Laennec laid it down that the closed hand of the subject was pretty nearly a mark of the size of the heart. This, however, is far from being the case; the heart of the infant at birth is larger than its closed hand, while the size of the hand varies according to the nature of the occupation of the person. It was supposed at one time that stature had considerable influence upon the size of the heart, and that this organ was always larger in tall than in short persons, in consequence of the greater distance to which the blood has to be transmitted. M. Bizot has, however, shown that stature has not the influence which was once supposed, and that whatever it exerts is rather in the opposite direction, the absolute size of the heart in both sexes being slightly less in tall persons; this, however, has been denied by M. Bouillaud. According to M. Bizot, the beadth across the shoulders has a greater influence than stature; the mean size of the heart and the width of the shoulders in both sexes being in a pretty regular ratio.

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[*] Guy's Hosp. Reports.

[†] Mem. de la Soc. Med. d'Observation. Tome I.

That the heart increases in size with the age of the individual,—that in advanced life it is larger than in the adult,—and that it is larger in proportion in the male than the female at every age, has been satisfactorily proved by M. Bizot. The results of accurate measurements of the heart in 156 individuals of all ages given by him, show that this organ regularly and progressively increases in all its dimensions—length, breadth, and thickness—up to the latest period of life; the increase being more rapid before twenty-nine years of age than after that period; and that the heart of the female at every period of life is smaller than that of the male.

The late Dr. Clendinning, whose researches were carried on about the same time, but without any knowledge of M. Bizot's labours, arrived at very nearly similar conclusions; his inquiries were particularly directed to determine the absolute weight of the heart in health and disease, as well as its relative weight to the entire body. Dr. Ranking, likewise, from the examination of anumber of healthy hearts, and M. Neucourt from researches carried on at the Saltpêtrière, in the service of MM. Valleix and Beau, have been able to corroborate some of M. Bizot's conclusions. M. Neucourt's examinations were limited to females in advanced life.

Length of the heart.—The length of the healthy heart in the adult, according to Meckel, measured from the centre of the auricles, is between five and six inches, four of which are for the ventricular, and one and a half for the auricular portion. Senac considered from three and a half to four inches to be the average length of the ventricular portion of the heart. According to M. Bouillaud, the mean length of the heart, from the base of the left ventricle or from the aortic orifice to the apex of the organ, in nine subjects was three inches seven lines and three quarters. Dr. Ranking,* from an accurate examination of thirty-two healthy hearts (fifteen male and seventeen female,) gives, as the mean length of the heart, measured from the point where the aorta emerges to the apex of the organ, four inches and one-third for the male, and three inches and a half for the female. In my examinations, the length of the heart, measured from the summit of the appendix of the right auricle to the apex of the left ventricle, ranged from four inches and a quarter to five inches and a half. I look upon five inches and a half to be the full length of the healthy adult heart.

Breadth of the heart.—The breadth of the heart across the base of the ventricles Meckel considers to be three inches; Senac, between two and two inches and a half; M. Bouillaud states that the average in eight hearts was three inches seven and a half lines, and the mean circumference at the base of the ventricles eight inches nine lines and three-sevenths. Dr. Ranking gives the mean circumference of the base of the heart in the male as slightly above nine inches and a half; in the female, about eight inches and a quarter. In the examinations which I have made, I have found the breadth of the heart across the ventricles to range between three inches and a quarter and four inches.

The following table, given by M. Bizot, shows the progressive increase in length and breadth of the heart from infancy to old age, as well as the comparative size of the heart in the male and female at different ages. Tho measurements are given in lines; the length is measured from the base of the ventricular portion to the apex; the width, at the part where the auricles and ventricles join one another:—

MALES.				FEMALES.			
Age.	Number of subjects.	Length.	Breadth.	Age.	Number of subjects.	Length.	Breadth.
1 to 4	7	$22\frac{4}{5}$	27	. . .	8	$22\frac{5}{8}$	$25\frac{7}{8}$
5 „ 9	3	$31\frac{1}{5}$	33	. . .	10	$26\frac{3}{5}$	29
10 „ 15	3	34	37	. . .	5	$29\frac{2}{5}$	$31\frac{1}{5}$
16 „ 29	18	$42\frac{5}{19}$	$45\frac{14}{19}$	. . .	14	$38\frac{5}{7}$	$42\frac{9}{14}$
30 „ 49	23	$43\frac{2}{23}$	$47\frac{18}{23}$	. . .	27	$41\frac{2}{27}$	$44\frac{1}{27}$
50 „ 79	19	$45\frac{12}{19}$	$52\frac{15}{19}$	50 to 89	19	$42\frac{4}{19}$	$46\frac{11}{19}$

Conclusions respecting the size of the heart.—From the preceding details it appears that—

1. The heart in both sexes gradually and progressively increases in size from infancy to old age; the increase being more rapid up to twenty-nine years of age than after that period.

2. The heart of the male is larger in all its imensions, at every period of life, than that of the female; and the ratio is nearly the same at all ages except infancy.

3. The breadth across the base of the ventricles exceeds the length of the ventricles at every age, and in both sexes.

4. The mean length of the ventricular portion of the healthy heart of the male, at the peiiod of

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* Medical Gazette.

life when this organ attains its maximum development, is slightly under three inches ten lines; in the female, under three inches seven lines.

5. The mean breadth of the ventricular portion of the healthy heart of the male in advanced life is below four inches five lines; in the female, below three inches eleven lines.

6. In persons of elevated stature the absolute size of the heart is not only not greater than in individuals of medium height, but, from M. Bizot's researches, appears to be rather less.

7. The capacity of the thorax, indicated by the width of the shoulders, has a greater influence upon the size of the heart than stature; and this organ is larger, as a general rule, where the shoulders are wide apart than in individuals with narrow shoulders.

Weight of the healthy heart.—Lancisi was the first to endeavour to determine the normal condition of the heart by weighing it; but until within the last few years we had no positive information respecting either the absolute weight of the healthy heart, or the ratio which the weight of the heart bears to that of the entire body; and it is to the researches of the late Dr. Clendinning that we are principally indebted for statistics under these heads. He has shown* that the absolute weight of the healthy heart varies with the age and sex of the subject; that in the female the weight is always below that of the male; and that in the male the weight increases gradually with the years as life advances; while in the female, although the absolute weight is rather less in old age than about fifty, the relative weight to the entire body increases as life advances after that period.

Absolute weight of the heart.—Senac considered the weight of the healthy heart of the adult to be between eight and ten ounces. Meckel lays down ten ounces as its average weight; Lobstein estimated it at between nine and ten ounces; Cruveilheir at between six and seven ounces; and Sanson at eight ounces and a half. Bouillaud says we may fix the mean weight of the heart in the adult between twenty-five and sixty years of age, at between eight and nine ounces: in thirteen cases given by him, the average was eight ounces three drachms, the maximum being eleven ounces, and the minimum being six ounces two drachms: the former, he observes, belonged to a subject of colossal stature, and of strong constitution; the latter to a subject of only sixteen years of age.

The following table, given by Dr. Clendinning,† shows the net average weight of the healthy heart at different ages, in the two sexes. Forty-eight of the subjects were males, and ninety-eight females; none are included in the table in which the weight of the heart reached eleven ounces avoirdupois:

Age.	Male.	Female.
15 to 30 . . .	8½ oz.	8¼ oz.
30 to 50 . . .	8½	8⅓
50 to 70 . . .	9½	nearly 8
70 to 100 . . .	9¾	8

Ratio of weight of heart to the body.—The ratio which the weight of the heart bears to the entire body is different at different ages, and in the two sexes. According to Meckel, in the infant soon after birth the ratio is as one to one hundred and twenty, while in the adult it is as one to two hundred. But, as Dr. Clendinning remarks, Meckel has not given particular observations, and possibly did not pay sufficient attention to differences of age, sex, and disease. The following table, given by Dr. Clendinning, shows the ratio which the weight of the heart bears to the entire body at different ages, and in the two sexes. This table includes twenty-three subjects under puberty, most of whom were under five years of age: forty-two males and fifty-eight females above puberty:—

Age.	Male.	Female.
Under puberty . .	1 to 146	1 to 153
15 to 30	1 to 164	1 to 169
30 to 50	1 to 150	1 to 161
50 to 70	1 to 161	1 to 187
70 and upwards . .	1 to 155	1 to 121

"The absolute weight of the healthy heart may therefore," Dr. Clendinning observes,* "be assumed to average for the whole of life above puberty, about nine ounces for the male, and eight ounces, or a little more, for the female; and to bear after death to the entire body the ratio of about one to one hundred and sixty for the male, and one to one hundred and fifty for the female." So that a male adult heart considerably exceeding the 160th part of the whole subject, might, for a person of the working classes, and of ordinary fatness, but of much muscularity, be held to be normal; while a heart of like absolute dimensions, but occurring in a subject of average stature and muscularity, would be justly considered hypertrophous, although, owing to general obesity or œdema, it should not exceed, or should even fall short of, the 160th part of the weight of the person. And this observation applies *mutatis mutandis*, to the female; in whom, I think, the extremes of obesity and leanness more frequently occur than in the male." The female stature and muscular development vary considerably less than the male, and the limits of normal nutrition, and the volume of the heart, are consequently narrower; so that any female heart greatly exceeding eight ounces in weight or volume may *ipso facto* be suspected of hypertrophy, whatever may be its apparent anatomical condition; and but few instances indeed, if any, will be met with, I apprehend, of female hearts exceeding nine ounces in volume, or nine and a half in weight, in the persons of individuals of ordinary stature and conformation, that had been quite free from pectoral disease during their lives."

Comparative weight of parts of the heart.—We possess but few statistics bearing upon the comparative weight of the several parts of the heart one to another. According to Valentin, the weight of the left ventricle is double that of the right; and he calculates from this that the force exerted by the right ventricle in its systole is only half that of the left; allowing two-thirds of the force of the septum to the left ventricle and one-third to the right. Ludwig states as the result of weighing the muscular substance of the ventricles, in both a moist and dry state, that the tissue of the left ventricle contains much less water than the right; consequently it has a much greater relative weight when dried.

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* Med. Chir. Transactions.

† Medical Gazette, Vol. xxii

* Medical Gazette, Vol. xxii.

Conclusions respecting the weight of the heart:

1. The absolute weight of the heart increases with the years, as life advances, in a very perceptible manner in the male. In the female there is no increase in its absolute weight after fifty years of age.
2. The absolute weight of the heart is greater in the male than the female at every age.
3. The average absolute weight of the healthy adult heart may be set down as nine ounces for the male, and eight ounces, or a little more, for the female.
4. The ratio which the weight of the heart bears to the entire body is different at different ages, and in the two sexes.
5. In infancy, in both sexes, the ratio of the weight of the heart to the entire body is greater than in the adult. In advanced life it is greater than at the middle periods.
6. In the female in advanced life the ratio of the weight of the heart to the entire body is much greater than in the male at the same period of life.
7. In estimating the weight of the heart, in doubtful cases, the relative as well as the absolute weight of the organ ought to be taken.

Dimensions of the healthy heart, continued—Thickness of the parietes—Left ventricle—Right ventricle—Septum ventriculorum—Auricular walls—Conclusions respecting the thickness of the parietes of the heart—Capacity of the several cavities of the heart—Conclusions respecting—Diameter of the orifices of the heart—Right auriculo-ventricular orifice—Left auriculo-ventricular orifice—Aortic and pulmonary orifices—Conclusions respecting the diameter of the orifices of the heart—Relative position of the several parts of the heart to the parietes of the chest—Relative position of the orifices of the heart to the parietes of the chest—Relative position of the orifices of the heart to one another—Relative position of the large vessels to the parietes of the chest.

DIMENSIONS OF THE HEALTHY HEART.

Thickness of the parietes.—The parietes of the several cavities of the heart have not the same thickness; as a general rule, the walls of the left chambers are thicker than those of the right, and the parietes of the ventricles much exceed those of the auricles; the left ventricle has much thicker walls than the right, and the walls of the left auricles are a little thicker than those of the right.

Left ventricle.—According to M. Bouillaud[*] the average thickness of the walls of the left ventricle, near its base, in ten subjects, was six lines and a half; we may consider (he adds) seven lines as the average thickness of the parietes of this ventricle. According to Dr. Ranking[*] the mean thickness of the walls of the left ventricle in the male, at a point about an inch distant from the origin of the aorta, is 27-48ths of an inch; in the female 23-48ths of an inch. M. Bizot's researches[†] prove that the parietes of the left ventricle, in both sexes, go on increasing in thickness from youth to advanced age; and that the thickest part of its walls is at the middle, next at the base, and that the thinnest part is at the apex.

The accompanying table, given by him, shows the mean thickness (in lines) of the parietes of the left ventricle at these three points, in the male and female, at different ages:—

Left Ventricle.

MALE.				FEMALE.			
Age.	Base.	Middle.	Apex.	Age.	Base.	Middle.	Apex.
16 to 29	4 2-9	3 7-9	3 4-9	16 to 29	4 2-7	4 7-13	3 5-28
30 to 49	4 17-46	5 1-11	3 13-23	30 to 49	4 1-9	3 27-54	3 6-27
50 to 79	4 37-38	5 29-38	4 1-29	50 to 89	4 1-2	5	3 3-4
Mean average between 16 and 79	4 65-122	5 19-122	3 95-122	Mean average between 16 and 89	4 3-8	4 4-5	3 13-30

Right ventricle.—According to M. Bouillaud, the average thickness of the walls of the right ventricle in ten subjects was two lines three-fifths: we may therefore, he says, consider two lines and a half as the average thickness of the parietes of the right ventricle. According to Dr. Ranking, the mean thickness of the walls of the right ventricle in the male, at a point about an inch distant from the origin of the pulmonary artery, is 8-48ths of an inch; in the female 6-48ths of an inch. According to M. Bizot, the thickest part of the parietes of the right ventricle is not at the same point as on the left side, but is close to the base of the heart; and the parietes of this ventricle remain nearly stationary at the different periods of life, being, however, a little thicker in advanced life than at an earlier period.

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[*] Traité des Maladies du Cœur, 2nde edition.

[*] Medical Gazette.

[†] Mém. de la Soc. Med. d'Observation, tome i.

The following table, given by M. Bizot, shows the mean thickness (in lines) of the parietes of the right ventricle at three distinct points, in the male and female at different ages:—

Right Ventricle.

MALE.				FEMALE.			
Age.	Base.	Middle.	Apex.	Age.	Base.	Middle.	Apex.
16 to 29	1 27-38	1 8-19	1 1-19	16 to 29	1 4-7	1 2-7	25-28
30 to 49	1 39-46	1 7-23	45-46	30 to 49	1 19-22	1 13-54	25-27
50 to 79	2 1-19	1 53-168	81-84	50 to 79	1 1-4	1 1-4	1
Mean average between 16 and 79	1 113-122	1 99-244	1 2-61	Mean average between 15 and 59	1 2-3	1 7-24	673-720

Septum ventriculorum. According to Dr. Ranking, the mean thickness of the septum of the ventricles, taken at its centre, in fifteen males between 26 and 65 years of age, was 22-48ths of an inch. In seventeen females, between the age of 18 and 62, 14-48ths of an inch. M. Bizot's researches show that the thickness of the septum of the ventricles goes on increasing from infancy to an advanced period of life; and that it is thicker in the male than in the female. The following table, given by him, shows the average thickness, in lines, of this part at its centre, in the male and female at different ages.

Age.	Male.	Female.
16 to 29	4 17-18	4 11-14
30 to 49	4 21-23	4 11-27
50 to 79	5 1-3	5 3-19

Auricular walls.—The walls of the left auricle exceed those of the right in thickness; but statistics are wanting under this head. M. Bouillaud is almost the only writer who has given measurements. According to him, the average thickness of the parietes of the left auricle in four subjects was one line and a half; of the right auricle one line.

Conclusions respecting the thickness of the parietes of the heart.—From the preceding details it appears that—1. The parietes of the left ventricle are thicker in the male than in the female heart at every age.

2. The parietes of the left ventricle and of the septum ventriculorum increase in thickness as age advances in both sexes.

3. The parietes of the right ventricle increase also in thickness as age advances in both sexes, but in a much less ratio.

4. The thickest part of the parietes of the left ventricle is at the centre, next at the base, and it is thinnest at the apex.

5. The thickest part of the parietes of the right ventricle is at the base.

6. The thickest part of the septum ventriculorum is at its centre.

7. The mean thickness of the parietes of the left ventricle, or of the septum, in the healthy heart of the male in advanced life, when the walls of the heart attain their maximum development (viz. between 50 and 79 years of age,) and at the thickest part, is under six lines.

8. The mean thickness of the parietes of the left ventricle in the female, between 50 and 89 years of age, is five lines.

9. The mean thickness of the parietes of the right ventricle in the healty heart of the male, between 50 and 79 years of age, and at its thickest part, is a fraction above two lines; in the female, one line and a quarter.

10. The mean thickness of the parietes of the left ventricle is, therefore, in both sexes, nearly three times as great as that of the right ventricle, as was long since laid down by Riolanus.

Capacity of the cavities.—The capacity of the several cavities of the healthy heart is not the same: the auricles exceed the ventricles in this respect; the right auricle likewise exceeds the left, and the capacity of the right ventricle is greater than that of the left. The capacity of both ventricles increases gradually as life advances in both sexes: the increase is more rapid in youth; after fifty years of age it is less marked, although it still goes on; so that, both in infancy and old age, the ratio between the capacity of both ventricles is the same.

That the capacity of the right ventricle is greater than that of the left was suspected long before it was actually proved. Senac says repeated examinations have convinced him that the capacity of the right ventricle exceeds that of the left; but that the difference is almost insensible in some subjects. M. Bouillaud repeats nearly Senac's words: he says—" the medium capacity of the right ventricle exceeds that of the left; but the difference is really very slight." This position has, however, been denied by some writers, and the apparently increased capacity of the right ventricle has been supposed to depend upon the accumulation of blood in the right cavities of the heart after death. " There is much reason to believe (Dr. A. Thomson observes*) that the greater capacity of the right auricle and ventricle depends in part upon the accumulation of blood which generally takes place in most kinds of slow death in the pulmonary arteries; and in part also upon the greater thinness, and consequent distensibility, of the right ventricle. In men dying suddenly, and in animals killed purposely, in which the pulmonary artery is opened so as to allow of the free egress of the blood from the right side of the heart, the capacity of this ventricle is not greater than that of the left, and the proportions of the capacity of the two sides of the heart usually found after slow death are sometimes reversed when a ligature is placed on the aorta, and the pulmonary artery is opened." But, as was long since remarked by Senac, "since in the fœtus the capacity of the right ventricle exceeds that of the left, it would be strange if in the adult they should have the same capacity." While M. Bizot's researches have proved that the right ventricle exceeds the left in capacity at every age; that this is the normal condition of the parts; and that it is not at all owing to the accumulation of blood during the last moments of life.

The actual capacity of each of the ventricles has been endeavoured to be determined by filling their cavities with fluid or with injection; but, as the parietes of the right ventricle are much more yielding than those of the left, this method is calculated to lead into error; indeed, Senac says he has introduced a pound and a half of injection into the cavities of the heart without using much force. According to him, each ventricle holds about two ounces of fluid; but the excess over this is very variable, the right sometimes holding from one to four drachms more. Hales estimated the capacity of the left ventricle at one fluid ounce and a half, and that of the right at two fluid-ounces. Each ventricle, on an average, it is generally considered, will contain a hen's egg, and, when moderately distended, is capable of holding from an ounce and a half to two fluid-ounces, or a little more.

M. Bizot determined the capacity of the ventricles by laying open their cavities, and measuring accurately the internal surface from above downwards, and transversely. From his researches it appears that both ventricles are wider than long in both sexes, and at every age; that the length, but particularly the breadth of the right ventricle, exceeds that of the left at all ages; that the capacity of the ventricles is greater in the male than the female; and that the relative capacity of the two ventricles is pretty nearly the same in advanced life and in infancy.

The following table, given by him, shows the average dimensions (in lines) of the interior of the cavities of both ventricles in the two sexes, and at different ages:—

Left Ventricle.

MALE.			FEMALE.		
Age.	Length.	Width.	Age.	Length.	Width.
16 to 29	$33\frac{14}{19}$	$51\frac{1}{19}$	16 to 29	$29\frac{9}{14}$	$47\frac{6}{13}$
30 ,, 49	$29\frac{11}{23}$	$53\frac{4}{23}$	30 ,, 49	$31\frac{16}{17}$.	$46\frac{4}{17}$
50 ,, 79	36	$56\frac{2}{3}$	50 ,, 79	31	49½
Mean average between 15 and 79	$34\frac{24}{61}$	$54\frac{9}{61}$	Mean average between 15 and 89	$31\frac{1}{30}$	$48\frac{23}{30}$
Right Ventricle.					
16 to 29	$36\frac{15}{19}$	$79\frac{5}{19}$	16 to 29	35	$74\frac{5}{14}$
30 ,, 49	$37\frac{13}{23}$	$83\frac{10}{23}$	30 ,, 49	$33\frac{13}{27}$	$76\frac{17}{27}$
50 ,, 79	$37\frac{1}{3}$	87	50 " 79	$35\frac{11}{19}$	76
Mean average between 15 and 79	$37\frac{14}{61}$	$82\frac{11}{60}$	Mean average between 15 and 89	34	$76\frac{3}{5}$

The capacity of the right auricle exceeds that of the left: the proportions established in the "Mémoires de l'Academie" between them are as twenty-four to thirteen; according to Santorini, as five to three; but the inequality is seldom so marked in the perfectly healthy heart. According to Dr. Sibson,† the capacity of the right auricle is about the same as that of the right ventricle; while the capacity of the left auricle is less than that of the left ventricle. He, however, estimates the capacity of both ventricles as the same.

Conclusions respecting the capacity of the cavities of the heart.

1. The capacity of both ventricles increases gradually as life advances in both sexes, the increase being more rapid in youth.

2. The ratio between the capacity of each ventricle is pretty nearly the same at all ages.

3. The capacity of both ventricles is greater in the male than in the female.

4. The capacity of the right ventricle much exceeds that of the left at all ages, and in both sexes.

5. The right ventricle holds, when moderately distended, about two fluid-ounces; the left ventricle about one ounce and a half.

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* Cyclopædia of Anatomy and Physiology.

† Trans. of Prov. Association, vol. xii.

6. The capacity of the right auricle exceeds that of the left; and the capacity of the auricles is greater than that of the corresponding ventricles; but further statistics are required under this head.

Diameter of the orifices.—The size, as well as the shape, of the arterial and auriculo-ventricular orifices is different: the former have a circular, the latter rather an elliptic form; the left auriculo-ventricular orifice has more of a crescentic shape than the right. The orifices of the right side of the heart exceed in size those of the left: this, however, applies more to the auriculo-ventricular than to the arterial orifices, as in advanced life the aortic orifice rather exceeds the pulmonary in size. M. Bizot's researches likewise show that the diameter of all the orifices of the heart is greater in the male than in the female, and that their size progressively increases as life advances in both sexes from puberty to old age.

In order to determine the diameter of the orifices of the heart, the most convenient method is to lay open the part by an incision through it, and take its circumference, from which the diameter is readily calculated. When the orifice is diseased, or if we wish to preserve the preparation, we must be content with measuring the diameter by means of a pair of compasses.

Right auriculo-ventricular orifice.—According to Cruveilhier, the long diameter of this orifice is from sixteen to eighteen lines; its short diameter twelve lines. M. Bouillaud found the average circumference of this orifice in three healthy hearts to be three inches ten lines; the maxmium being four inches, the minimum three inches nine lines. According to Dr. Ranking, the mean circumference of this orifice in fifteen males was 4 inches 35-48ths; in seventeen females, 4 inches 8-48ths. In the measurements which I have made, I have found the long diameter of this orifice to range between fourteen and sixteen lines and a half.

The following table, given by M. Bizot, shows the mean circumference (in lines) of this orifice at different ages in the male and female.

Right auriculo-ventricular orifice.

MALE.		FEMALE.	
Age.	Lines.	Age-	Lines.
16 to 29	50 9-19	16 to 29	37 12-13
30 „ 49	54 5-23	30 „ 49	47 4-27
50 „ 79	57⅓	50 „ 89	49 13-19
Mean average between 16 & 79	54 12-61	Mean average between 16 & 89	48¼

Left auriculo-ventricular orifices.—According to Cruveilhier, the long diameter of this orifice is from thirteen to fourteen lines; its short diameter from nine to ten lines. M. Bouillaud states that the average circumference in three harts examined by him was 3 inches 6⅓ lines; the maximum being 3 inches 10 lines, the minimum 3 inches 3 lines. According to Dr. Ranking, the mean circumference of this orifice in the male is 3 inches 45-48ths; in the female, 3 inches 22-48ths. In the examinations which I have made, the long diameter of this orifice, measured from the auricle, ranges between ten and twelve lines.

M. Bizot has given the following table of the mean circumference (in lines) of this orifice in the two sexes at different ages:—

Left auriculo-ventricular orifice.

Male.		Female.	
Age.	Lines.	Age.	Lines.
16 to 29	41	16 to 29	38
30 „ 49	48 9-22	30 „ 49	40 17-26
50 „ 79	48 13-19	50 „ 89	44 4-19
Mean average between 16 and 79	45 17-30	Mean average between 16 and 89	41⅓

Aortic orifice.—According to M. Bouillaud, the average circumference of the aortic orifice in four healthy hearts was 2 inches 5½ lines; the maximum being 2 inches 8 lines; the minimum, 2 inches 4 lines. According to Dr. Ranking, the mean circumference of this orfice, on a line with the insertion of the semilunar valves, in fifteen males between twenty-six and sixty-five years of age, was nearly 2¾ inches; in seventeen females, between eighteen and sixty-two years of age, 2 inches 22-48ths. According to Dr. Chevers, the circumference of the aortic orifice, immediately below the semilunar valves, is 36½ lines; above them, 34 lines. In the examinations which I have made I have found the diameter of this orifice to range between ten and twelve lines. The accompanying table, given by M Bizot, shows the mean circumference (in lines) of the aortic orifice, at the free border of the semilunar valves, in the male and female, at different ages:—

Aortic orifice.

Male.		Female.	
Age.	Lines.	Age.	Lines.
16 to 29	26 10-19	16 to 29	24 3-9
30 „ 49	30 20-23	30 „ 49	28 3-27
50 „ 79	36	50 „ 89	32 5-6
Mean average between 16 and 79	31 15-61	Mean average between 16 and 89	28 4-5

Pulmonary orifice.—M. Bouillaud found the mean circumference of the pulmonary orifice in four healthy hearts to be 2 inches 7¾ lines; the minimum, being 2 inches 10 lines; the maximum 2 inches 6 lines. According to Dr. Ranking, the mean circumference of the pulmonary orifice in the male is 2 inches 34-48ths; in the female, 2 inches 24-48ths.

The following table, given by M. Bizot, shows he mean circumference (in lines) of this orifice, at the free border of the sigmoid valves.

Pulmonary orifice.

Male.		Female.	
Age.	Lines.	Age.	Lines.
16 to 29	29 2-19	16 to 29	28 3-14
30 „ 49	31 12-23	30 „ 49	$29\frac{1}{3}$
50 .. 79	35	50 „ 89	32 17-36
Mean average between 16 and 79	32 21-61	Mean average between 16 and 89	30 7-60

Conclusions respecting the diameter of the orifices of the heart.—From the preceding details it appears that—

1. The diameter of all the orifices of the heart is greater in the male than the female at every age.

2. The diameter of all the orifices of the heart increases gradually from birth to old age in both sexes.

3. The auriculo-ventricular orifices exceed the arterial orifices in size at every age, and in both sexes.

4. The right auriculo-ventricular orifice exceeds the left in size in both sexes, and at every period of life, except in the female between the ages of sixteen and twenty-nine, when according to M. Bizot, there is a very slight excess of the left over the right.

5. The pulmonary orifice exceeds the aortic orifice in size in both sexes, up to the age of fifty; after this period the aortic orifice slightly exceeds the pulmonary orifice.

6. The mean circumference of the right auriculo-ventricular orifice, in the healthy heart of the male, in advanced life, when the orifices of the heart attain their maximum size,—viz. between fifty and seventy-nine years of age—is, omitting fractions of lines, 4 inches 9 lines; of the left auriculo-ventricular orifice, four inches.

7. The mean circumference of the right auriculo-ventricular orifice in the female, between fifty and eighty-nine years of age, is (omitting fractions of lines) 4 inches 1 line; of the left, 3 inches 8 lines.

8. The mean circumference of the pulmonary orifice in the male in advanced life is 2 inches 11 lines; of the aortic orifice, 3 inches.

9. The mean circumference of the pulmonary orifice in the female, between sixteen and eighty-nine years of age, is about 2 inches 8 lines; of the aortic orifice, 2 inches 8 lines.

Relative position of the several parts of the heart to the parietes of the chest.—A knowledge of the exact position of the several parts of the heart, particularly of its valves and orifices, and of their relation to fixed points on the parietes of the chest, is of considerable importance in the diagnosis of the diseases of this organ, as it enables us to determine the size of the heart in the living subject, to ascertain whether it is increased or diminished in any of its diameters, or whether it is displaced, and the amount of the displacement; and by it we can often determine which of the valves or orifices is diseased, as well as the nature of the morbid change.

The apex and body of the heart being capable of some change of position, according to the posture of the patient, and according to the motions of the diaphragm, and the base of the organ, from which the large vessels proceed, being more fixed, the latter is the most convenient point from which to trace the outline of the heart, or to determine what parts correspond to certain fixed points upon the surface of the chest.

The sternum in front, with the cartilages of the true ribs, laterally form, in a great measure, the anterior boundaries of the heart; a small portion only of this organ near its apex extends on the left side beyond the cartilages of the ribs. The base of the ventricular portion of the heart is from three to three and a half inches below the clavicle, and on a line with the junction of the cartilage of the third left rib with the sternum. The impulse of the apex of the organ is felt between the fifth and sixth left ribs, near where the body of these ribs joins the cartilage. A line, therefore, drawn between these two points gives the length of the ventricular portion of the healthy heart. In addition, the nipple in the male constitutes a useful guide: it is situated immediately opposite the lower edge of the fourth rib, a little more than an inch to the left of the junction of this rib with its cartilage. Thus we have a certain number of well-marked and easily distinguished points, to which any part of the heart situated underneath can be readily referred. It is necessary, however, to bear in mind (Dr. Sibson[*] observes) in examining the dead subject, that the lower margin of the pericardial sac is lower than the margin of the heart, as this organ, after the last vital contraction, contains less blood than during life, and retracts upwards.

The greater portion of the *right ventricle* lies behind the sternum; a portion of its upper part extends to the right of this bone, and its apex extends to the left of the sternum.

All the anterior surface of the *left ventricle* is to the left of the sternum; its left margin reaches to the nipple on the left side.

The *right auricle* is to the right of the sternum; its appendix lies behind the cartilage of the third right rib; its tip rests against the right side of the ascending portion of the arch of the aorta, and is on a line with the pulmonary valves.

The appendix of the *left auricle* is the only portion of it which is seen when the pericardium is laid open; it lies behind the cartilage of the third left rib, close to the sternum, resting against the left side of the commencement of the pulmonary artery.

The base of the heart,—that is, of the auricular portion,—is on a line with the interval between the junction of the second and third ribs with the sternum, the greater portion of it being under the sternum.

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[*] Trans. of Prov Association, vol. xii.

The base of the ventricular portion of the heart on the left side rises as high as a line drawn across the junction of the cartilage of the third left rib with the sternum; that is, about three inches below the clavicle on that side. On the right side, owing to the oblique position of the heart, the base of the right ventricle corresponds to a line across the upper margin of the junction of the cartilage of the fourth right rib with the sternum.

The apex of the left ventricle is a little below the fifth left rib, to the left of the junction of this rib with its cartilage, and on a line with the articulation of the xyphoid cartilage with the sternum.

Relative Position of the Orifices of the Heart to the Parietes of the Chest.

The right auriculo-ventricular orifice lies behind the centre of the sternum, on a line with the lower margin of the articulation of the cartilages of the fourth ribs with the sternum.

The left auriculo-ventricular orifice lies behind the cartilage of the fourth left rib, near the sternum.

The pulmonary valves are on a line with the space between the cartilages of the second and third ribs, to the left of the sternum, and very close to this bone. In some instances they lie a little lower down,—viz. on a line with the junction of the cartilage of the third left rib with the sternum, and immediately under it.

The aortic valves lie behind the sternum, on a line with the junction of the cartilages of the third ribs with the sternum, and towards the left edge of this bone. When the valves of the pulmonary artery are situated lower down, the semilunar valves of the aorta will be lower also, and on a line with the interval between the insertion of the cartilages of the third and fourth ribs.

The free edge of the semilunar valves of the aorta corresponds accurately, M. Gendrin observes, to the base of the pulmonary valves. A line drawn across the inferior margin of the third ribs corresponds to the base of the valves of the pulmonary artery, and to the free border of the aortic valves.

Relative Position of the Orifices of the Heart to one another.

The right ventricle ascends higher than the left, and the left ventricle descends lower than the right. Hence the origin of the pulmonary artery is on a plane above that of the aorta.

The pulmonary orifice is the highest up, as well as the most anterior, of all the orifices of the heart. The aortic orifice lies behind it, and on a plane lower down. The left auriculo-ventricular orifice is immediately behind the aortic orifice, but on a plane lower down. The right auriculo-ventricular orifice is nearly on the same plane as the left, but more anterior.

Relative Position of the Large Vessels to the Parietes.

Aorta.—The ascending portion of the arch of the aorta comes to the right of the sternum, between the cartilages of the second and third ribs. In this part of its course it is within the pericardial sac, and in the dead subject lies at the depth of one inch and a half from the surface, the margin of the right lung and the pericardium being between it and the parietes of the chest. The transverse portion of the arch of the aorta crosses the trachea at the centre of the first bone of the sternum, on a line with the lower margin of the articulation of the cartilages of the first ribs with the sternum, and at a still greater depth from the surface. The arch of the aorta approaches most closely to the parietes at the point at which the arteria innominata comes off; that is, on a line with the junction of the cartilage of the second right rib of the sternum.

Pulmonary Artery.—The origin of the pulmonary artery is on a line with the junction of the cartilages of the third ribs with the sternum; the tip of the left auricle resting against its left side: it ascends about two inches before it divides; and a portion of the margin of the vessel here comes to the left of the sternum, between cartilages of the second and third ribs. The division of the artery is on a line with the upper edge of the cartilage of the second ribs, where they join the sternum, the apex of the pericardial sac being on a line with the junction of the cartilages of the second ribs with the sternum, though it is sometimes higher up, and on a line with the cartilage of the first ribs.

Motions of the heart—Motions of each of its cavities—Auricular systole and diastole—Ventricular systole and diastole—Order of succession of the heart's motions—Duration of the several movements of the heart—Period of repose of the heart—Frequency of the heart's action, and of the pulse—Effects of posture on the pulse—Cause of the influence of change of posture on the pulse—Ratio of the pulsations of the heart to the respirations—Rapidity of the passage of the blood through the heart—Force with which the blood is propelled by the left ventricle.

Motions of the heart.—The heart we have seen to be composed essentially of muscular tissue. As a muscular organ, it is adapted to perform certain motions. These consist in alternate contractions and relaxations of its muscular fibres; but the heart being a hollow viscus, and divided in its interior into distinct chambers, the contraction and relaxation of its muscular parietes must necessarily occasion the diminution and enlargement of its cavities, and of course react upon the blood they contain. The ventricles are the parts of the heart upon which the circulation mainly depends; the auricles (as was remarked by Hunter) are to be considered rather as reservoirs, "capable of holding a sufficient quantity of blood to supply the ventricles, and ready always to fill them as they are in need of it."

The function of the heart, it is scarcely necessary to observe, is the circulation of the blood;

it is the principal agent in this important process; and, as life depends upon its regular and constant action, the motions of the organ are altogether independent of the will. The heart, therefore, considered as a muscular viscus, belongs to the class of involuntary muscles, its movements being not only uninfluenced by the will of the individual, but carried on without his consciousness.

The manner in which the motions of the heart are performed, the order in which they succeed each other, and the phenomena which characterise its movements, have been determined by an examination of the heart in animals, where the parietes of the thorax had been removed and the heart exposed, the animal having been previously deprived of sensation, and artificial respiration kept up. The opportunity has likewise been occasionally afforded of examining this organ in the human subject in certain rare cases of congenital malformation, where the infant was born with a deficiency of the anterior parietes of the thorax, and the heart presented itself naked and uncovered to the view. Few parts of our subject have been more frequently or more carefully investigated than this, and there are few upon which a greater amount of time, labour, and talent, have been bestowed.

The motions of the heart consist, as I have said, of alternate contractions and relaxations of the parietes of its several cavities. The contraction of the ventricles, or their systole, as it is commonly termed, constitutes their active state; as soon as this ceases the muscular tissue relaxes, their cavities enlarge, and return to a state of fulness; when the ventricle is said to dilate, or its diastole, as it is termed, occurs. By the ventricular systole the blood is propelled into the aorta and pulmonary artery: as the ventricles re-expand, the blood, favoured by gravity, passes in a full stream from the auricles into the ventricles, to be again expelled when the ventricular systole ensues.

From the Report of the Committees of the British Association for 1838-39 and 1839-40, it appears that "the visible systolic and diastolic motions are first perceived at the bases or fixed parts of the cavities; viz. in the auricles at the sinuses, and in the ventricles at the fundus cordis; and that the apices of the auricles and ventricles, or free parts, are brought into full action after the others, and only just before the supervention of the opposite and next succeeding condition of the cavities respectively, whether that condition be systole or diastole."

It will now be necessary to consider separately the motions of each of the cavities of the heart.

Auricular systole.—The systole of the auricles is a quick, short, sudden motion. Lower says its rapidity equals the explosion of gunpowder. It immediately precedes the ventricular systole, the one motion appearing to be propagated into the other. It commences in the sinus, and extends to the appendix, but by a very minute interval. According to some authorities, it is first observed in the appendices. In feeble states of the heart's action it becomes vermicular.

The auricular systole is most apparent in the appendices, and is very feeble compared to that of the ventricles. By it a small additional quantity of blood is propelled into the ventricles; but its contraction is too slight either to empty the auricular cavities or to cause the dilatation of the ventricles. In the majority of cases, likewise it is too feeble to produce sound. Nevertheless, in some of the experiments of the Committee of the British Association, and in those conducted in America by Drs. Pennock and Moore, sound, though faint, was sometimes heard, which, in a great degree, merged into that of the ventricular systole, but still was real. The auricular systole occurs towards the end of the period of repose of the heart; its duration is about the eighth part of an entire beat of the heart.

Auricular diastole.—The diastole of the auricles is a passive movement: these cavities are gradually and progressively distended, from the sinus to the appendices, by the blood which enters from the venæ cavæ and pulmonary veins. It continues from the termination of one auricular systole to the commencement of the next, so that it persists through the systole of the ventricles, during their diastole, and during part of the interval of repose. M. Cruveilhier states, that the right auricle during its diastole (in a case of ectopia of the heart, which he had the opportunity of examining,) seemed ready to burst, so distended was it, and so thin its parietes: the left did not exhibit the same appearance, at least so decidedly. The duration of the diastole of the auricles is about seven-eighths of an entire beat of the heart.

Ventricular systole.—The systole of the ventricles is a gradual, progressive, and gliding movement, and performed with great force: it commences suddenly, instantly succeeding the auricular systole, so that the one movement appears to be propagated into the other. During their systole the parietes of the ventricles become pale, hard, and convex; the vertical and transverse diameters are diminished, the apex is approximated to the base, and describes a spiral motion from right to left, and from behind forwards, coming in contact with the parietes of the thorax between the cartilages of the fifth and sixth ribs on the left side, where the impulse of the heart is felt. Dr. Sibson* (in some experiments made by him) says, the ventricles in contracting, felt "like the pushed, revolving point of a pencil." "Wherever (he observes) "the junction of the left ventricle to the auricle could be observed, the apex and base of the ventricle were seen to approach each other steadily during the whole systole; so that, at the end of the systole, the apex was about the third of an inch nearer the left auricle than at the beginning, and the aorta was drawn downwards about a quarter of an inch."

In the experiments performed by Drs. Pennock and Moore,† the apex of the left ventricle was not observed to be approximated to the base during

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* Trans. of Prov. Association, vol. xii.

† Medical Examiner, Nov. 1839.

its systole. The expulsion of the blood from the ventricles (they observe) is effected by an approximation of the sides of the heart only, and not by a contraction of the apex towards the base: during the systole, the heart performs a "spiral movement, and becomes elongated." All other observers have, however, noticed the shortening from above downwards of the ventricular portion of the heart during the systole; and from the manner in which the fleshy columns of the valves are inserted, such would appear to be essential to the perfect action of the auriculo-ventricular valves, when the ventricles contract.

The phenomena presented by the systole of the ventricles have been well described by Mr. Cruveilhier,* as observed by him in a case of ectopia of the heart, in an infant which lived for about fourteen hours.

"During their systole the ventricles become pale, their surface wrinkled, the superficial veins swollen, and the spiral fibres which form the apex of the heart become more evident. At the same time the ventricles diminish in all their diameters, the appearance of shortening being most perceptible in the vertical diameter."

"During the systole of the ventricles, the apex of the heart (that is, of the left ventricle) describes a spiral or turnscrew motion from right to left, and from behind forwards. This spiral movement is slow, gradual, and, as it were, successive; and it is to it that the impulse of the apex of the heart is due. The ventricular systole is not accompanied by a motion of projection of the heart forwards: it is the spiral contraction exclusively which projects the apex of the organ against the parietes of the thorax."

The ventricles do not appear to empty themselves completely during their systole; this, however, cannot be ascertained with certainty, owing to the thickness of their parietes; but, as Dr. Hope observes, the diminution of their volume is not in general so great as to convey the impression that they do. During the ventricular systole the blood is propelled with considerable force into the arterial orifices: the first sound of the heart is heard, and the impulse and pulse are felt. The systole of the ventricles occupies about one-half the period of an entire beat of the heart: that is, it is as long as the diastole, and the period of repose together, and is double the length of the ventricular diastole.

Ventricular diastole.—The diastole of the ventricles instantly succeeds the systole; it is a sudden and instantaneous movement; in it the ventricles increase in all their dimensions, the apex recedes from the base, the heart becomes elongated, the surface smooth, and it assumes the shape and position which it had previous to the systole. This movement of the heart has been divided into two stages; "the first, which immediately follows the ventricular systole, is sudden, the apex being pushed downwards, and *apparently* passing deeper into the chest, and is occasioned by the return of the heart to its state of rest." The second is also sudden, and attended by a rapid but not very extensive enlargement of the heart in all its dimensions." The force with which the ventricular diastole is accomplished is very considerable: in large animals, the hand grasping it is forcibly opened.

M. Cruveilhier gives the following account of the phenomena observed by him in the case of the infant before alluded to:—

"The ventricular diastole was sudden and instantaneous; the ventricular cavities became filled, swelled out, elongated, and the apex was projected downwards: it seemed at first sight as if this constituted the active movement of the organ, so rapid and energetic was it. One forms no idea of the force with which the dilatation overcomes any pressure upon the heart; the hand closed round it is violently opened."

"The ventricular diastole is accompanied by a movement of projection of the heart downwards, which was carried to the maximum when the infant was placed vertically. This motion was so decided that at first I was inclined to think that it was during the ventricular diastole that the impulse of the heart against the thoracic parietes occurred."

During the ventricular diastole the blood passes in a full stream from the auricles into the ventricles: it is not impelled by the auricles, neither is it the entrance of the blood which causes the ventricles to dilate; the utmost force of the auricular contraction could not cause the dilatation of the ventricles. Besides, the auricular systole does not occur until after the ventricular diastole. The duration of the diastole of the ventricles is brief compared to that of the systole, being about half the length of the former movement, and about one-fourth of the period of an entire beat of the heart; the second sound of the heart is synchronous with it.

Order of succession of the heart's motions.—The systole precedes the diastole in both the auricles and ventricles. The systole of the right and left auricle is synchronous, as is their diastole. The systole of the two ventricles is also synchronous, as is their diastole.

The systole of the auricles occurs during the latter part of the period of repose of the ventricles. The diastole of the auricles occupies the remainder of the period of repose of the ventricles, and the entire period of the ventricular systole and diastole. The systole and diastole of the ventricles occurs at the same period as the auricular diastole.

The order in which these several motions succeed each other is as follows:—

1. The auricular systole.
2. The ventricular systole.
3. The ventricular diastole.
4. The period of repose of the ventricles; during the latter part of which period the auricular systole occurs again.

From the termination of the diastole of the ventricles until the commencement of the next systole, "the ventricles are in a state of perfect repose, their cavities remaining full but not distended."

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* Gazette Médicale.

If the duration of the movements of the ventricles be divided into four equal periods, the ventricular systole would occupy about two; the ventricular diastole something more than one; and the interval of repose something less than one. Or in portions of a second, the ventricular systole would occupy about half a second; the diastole a little more than a quarter of a second; and the period of repose something less than the quarter of a second: and if represented on paper would be as follows:—

Ventricular systole. . . ————
Ventricular diastole . . ———
Period of repose . . . . ——

If the duration of the movements of the auricles be divided into eight equal parts, the auricular systole would occupy about one-eighth; their diastole the remaining seven-eighths: the auricular systole occupying part of the period of the repose of the ventricle; the auricular diastole occupying the remainder of the period of repose, as well as the period of ventricular systole and diastole.

Period of repose of the heart.—When the heart's action is very rapid, the alternate movements succeed each other so quickly that there appears to be no interval of repose. On the other hand, when it is very slow, two distinct intervals are distinguished—one short, between the systole and the diastole of the ventricles; the second longer, between the diastole and the next succeeding systole. The first of these intervals M. Gendrin proposes to call the *peri-systole;* the second, the *peri-diastole.* M. Volkmann states, that by employing a second's pendulum (the oscillations of which could be regulated at pleasure) he found the interval between the first and second sounds to bear to that between the second and first next sound the ratio of 96 to 100: "the intervals were, therefore (he observes,) almost equal, although, in the ordinary mode of examining the heart, this does not appear to be the case."

When the heart is beating with moderate frequency, but one distinct interval is perceived, which follows the ventricular diastole, and continues until the next succeeding systole. This is the pause in the heart's motions, or the interval of repose of the heart, and it corresponds to the *peri-diastole* of M. Gendrin. It occupies, as we have seen, nearly one fourth part of an entire beat, which would give about six hours' rest out of the twenty-four to the muscular fibres of the ventricles. But, as the muscular fibres of the ventricles are relaxed during their diastole, the period occupied by it may be added, which will make the period of repose or rest of the ventricles one half the time of an entire beat, or twelve hours out of the twenty-four, which was the period assigned by Laennec. As the auricular systole occupies only one-eighth part of an entire beat of the heart, and the diastole the remainder, the auricles (if the period of their diastole be considered as a state of repose) may be said to be at rest for twenty-one out of the twenty-four hours.

Frequency of the heart's action, and of the pulse.—The rapidity of the heart's action is not the same at every period of life: it varies also according to the sex, the temperament, and the idiosyncrasy of the individual: it differs at different periods of the day, and in different positions of the body, and it is remarkably influenced by affections of the mind.

In the female the heart's action is more rapid than in the male; the pulse of the adult female exceeding in frequency the pulse of the adult male, of the same mean age, by from nine to ten beats. According to Dr. Guy,[*] "the average pulse of the adult male may be stated at 70; that of the adult female at 80." "The female pulse (he observes) differs little from the male pulse during the first seven years of life; but after seven years of age the mean pulse of the female exceeds that of the male by from six to fourteen beats, the average excess being nine beats."

In early life the heart's action is much more rapid than in the adult; and in the adult it is somewhat more rapid than in advanced life. Thus, while in infancy the number of the pulsations of the heart average from 120 to 140 in a minute, the number in old age is usually between 50 and 70. The following table, given by Müller,[†] shows the average frequency of the heart at different ages:—

In the embryo the number of beats in a minute is	150
Just after birth	from 130 to 140
During the first year	115 " 130
" " second year	100 " 115
" " third year	90 " 100
About the seventh year	85 " 90
" " fourteenth year	80 " 85
In the middle period of life . . .	70 " 75
In old age	50 " 65

It was formerly supposed that the rapidity of the heart's action gradually and progressively diminished from birth upwards; that it was quickest soon after birth; and that there was a gradual and sensible diminution in its frequency after that period. The remarkable fact has, however, been ascertained, that the pulse of the infant soon after birth is not unfrequently as slow as that of the adult. M. Billard[‡] first called attention to this phenomenon, which has also been investigated and corroborated by M. Valleix.[§] According to him, the mean frequency of the pulse in thirteen healthy infants, from two to twenty-one days old, when asleep, averaged 87 in a minute; when awake, from 90 to 100: but it was readily excited by motion or emotion. From the seventh to the twenty-seventh month, the average was 119 for the male, and 124 for the female infant; and it continued a little above 100 up to the age of six years.

According to Mr. Gorham,[‖] the mean frequency of the pulse in sixteen infants under one

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[*] Cyclopædia of Anatomy and Physiology.

[†] Elements of Physiology, vol. i.

[‡] Traité des Maladies des Enfans.

[§] Mem. de la Soc. Med. d'Observation, T. 2.

[‖] MEDICAL GAZETTE, Vol. xxi.

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day old was 123; in forty-two observations on infants from one to seven days old, the average was 128. Dr. Guy says, the observations of MM. Billard and Valeix are by no means borne out by his experience. "There is reason to believe (he thinks) that these low frequences of the pulse of infants occur in that state and degree of debility, without disease, which gives rise to an infrequent pulse in the adult, and that they do not occur in strong and vigorous health."

The heart's action is less rapid during sleep than awake; this is probably connected in some manner with posture. The decrease in frequency of the heart's action occasionally observed in the fœtus in utero, has been attributed to the sleep of the embryo. The action of the heart is much slower when the individual is at rest than during or after bodily exertion. Dr. Bryan Robinson* states that the pulse of the adult, which ranged when at rest from 64 to 74, rose to 100 when walking at the rate of two miles an hour; to 140 when walking at the rate of four miles an hour; and when running fast, to 150 or more.

The heart's action is usually slightly accelerated after meals, particularly after the use of warm or spirituous liquors; and, contrary to the opinion at one time entertained, it is perceptibly quicker in the morning than in the evening. Dr. Knox,† who was the first to establish this fact, says the pulse is quicker by eleven beats, on an average, in the morning than in the evening. Dr. Guys‡ experiments corroborate those of Dr. Knox. In the article "Pulse," in the Cyclopædia of Anatomy and Physiology, he has given a series of tables showing the diurnal variations of the pulse in the two sexes: "the facts contained in which may (he observes) be taken to establish the general law first set forth by Dr. Knox, that the pulse is less frequent in the evening than in the morning; but it is obviously subject to numerous exceptions."

Effects of posture on the pulse.—Posture has a remarkable influence upon the rapidity of the heart's action; it is more frequent in the sitting than in the recumbent posture; and more frequent in the erect than in the sitting posture. Attention was first called to this remarkable fact above a hundred years ago, by Dr. Bryan Robinson, of Dublin, in his "Treatise on the Animal Economy." In the third edition of this work, published in the year 1738, he states that the pulse, which in the recumbent posture was sixty-four, rose to sixty-eight in the sitting posture, and to seventy-eight in the erect posture. The late Dr. Macdonnell, of Belfast, so long ago as the year 1784, determined experimentally this influence of change of posture on the pulse; he termed it "*the differential pulse*:" the results of his observation were communicated to the profession at the meeting of the British Association in Dublin. This phenomenon has also been investigated with much care by Dr. Graves of Dublin, and by Dr. Knox of Edinburgh, and by Dr. Guy of London.

According to Dr Graves,* the difference between the pulse in the erect and recumbent posture in the healthy adult is from six to fifteen beats in a minute; "if the pulse is but sixty, the difference is generally not more than six or eight, and this difference increases with the frequency of the pulse at the time of the experiment: thus, if it has been raised to 90 or 100 by moderate exercise, it is not unusual to find the difference twenty or thirty." That it is not the muscular exertion necessary to raise the body from the recumbent to the erect posture which occasions this difference, was proved by Dr. Graves, by altering the position without the necessity of any muscular exertion on the part of the person experimented on. He tried also the experiment of inverting the position, placing the person with the head downwards and the feet in the air; the frequency of the pulse was not, however, altered, but its strength diminished often very considerably, and it not unusually became irregular.

Dr. Knox† has shown that the increase in frequency of the pulse occasioned by change of posture, is different at the different periods of the day. "During the morning the mere change of the posture from the horizontal to the erect will increase the pulse by about fifteen or twenty beats; at midday this increase will be ten; and in the evening only four or six."

Dr. Guy instituted an elaborate series of experiments to determine the alterations effected on the pulse by change of posture. The following are some of his conclusions‡ under this head:—

"1. In the healthy adult male the mean Nos. of the pulse are—standing, 79; sitting 70; lying, 67.

"2. In the healthy adult female the Nos. are—standing, 89; sitting, 82; lying, 80.

"3. In both sexes the extremes are very remote from the mean results, and the exceptions to general rules very numerous.

"4. In both sexes, also, the effect of change of posture increases as the frequency of the pulse increases.

"5. The effect of change of posture on any given frequency of the pulse is much greater in the male than in the female.

"6. The effect of change of posture on the pulse is greater in the forenoon than in the other part of the day.

"7. The inverted posture of the body lessens the frequency of the pulse.

"8. The varying frequency of the pulse in different postures of the body is due to muscular contraction."

In states of debility, as in patients recovering from fever, the difference between the frequency of the pulse in the erect and recumbent postures becomes (Dr. Graves observes) a useful guide in the treatment: "the greater the difference the greater the debility." In hypertrophy, with dilatation of the ventricles, on the other hand, Dr. Graves found the pulse to be very little altered with respect to frequency on changing the position. In anæmic and chlorotic females, and in individuals who have suffered from profuse hæmorrhage, I have observed that the difference between frequency of the pulse in the recumbent and sitting posture is very marked; but these morbid states are always accompanied by more or less debility; and the pulse, in respect to frequency, is always above the normal standard.

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* Treatise on the Animal Economy, 3d edit.
† Ed. Med. and Surg. Jour. vol. xi.
‡ Guy's Hospital Reports, No. ix.

* Clinical Medicine, 2d edition.
† Ed. Med. and Surg. Journal, Vol. xi.
‡ Cyclo. of Anat. and Physiology—art. Pulse.

Cause of the influence of change of posture on the pulse.—With respect to the cause of this alteration in the frequency of the pulse in different positions of the body, writers are not agreed. Dr. Guy refers it exclusively to muscular contraction; by others it has been attributed to the altered position of the heart, its valves and orifices, in the different positions; while Dr. Graves says "he cannot advance even a plausible conjecture concerning the reason why a change of posture should so affect the frequency of the pulse" "The two postures (Dr. Guy observes) between which there is the most marked difference in the frequency of the pulse, viz., the erect and sitting postures, are precisely those in which there is no difference in the position of the heart or its valves, and very little difference in the resistance offered to the circulation: while the sitting and recumbent postures, between which there is so slight a difference in the number of the pulse, are accompanied by a marked change in the position of the heart and its valves, and of the column of blood to be propelled. On the other hand, the difference in the amount of muscular contraction required to support the body in the erect and sitting postures is much more considerable than that required to support the body in the sitting and recumbent position—differences in strict conformity with the observed frequencies of the pulse in the several postures."

It appears to me, that writers, in seeking to explain the influence of position upon the pulse, have erred in endeavouring to refer it exclusively to a single cause: it probably lies as much in the lungs as in the heart; the latter organ being indirectly excited in consequence of the increased frequency of the respiration. For instance, the chest expands less, and less air is taken in in inspiration, in the recumbent than in the erect or sitting postures; there is less of the feeling, likewise, which inclines to frequent renewal of the air in the former than in the latter position. In certain diseased states this becomes sufficiently obvious: whenever dyspnœa is urgent, no matter what may be its cause, the patient is unable to remain in the recumbent posture, and seeks to obtain ease by sitting up. As there is less necessity for the blood to circulate quickly through the lungs in the recumbent than in the erect or sitting posture, the respirations are less frequent, and the general circulation is likewise less rapid.

At the same time, there can be no doubt that the venous blood is returned from the head and upper extremities to the right side of the heart more quickly and more freely in the erect and sitting than in the recumbent posture, being remarkably favoured by gravity in the former positions: the pulmonary circulation and the respirations necessarily, therefore, increase in frequency: the left side of the heart then feels its influence, the blood being conveyed more rapidly to it, and the general circulation becomes quickened in the same ratio. Hence there is no difficulty in understanding why the pulse should be more rapid in the one position than the other. Its increased rapidity in the erect over the sitting posture is probably favoured by muscular contraction, as stated by Dr. Guy.

Ratio of the pulsations of the heart to the respirations.—Under ordinary circumstances the proportion which the respirations bear to the pulsations of the heart is about as *one* to *four;* this was the ratio established by MM. Prevost and Dumas: the average number of respirations in a minute, in a healthy adult, being between sixteen and twenty, and the number of pulsations of the heart between sixty-four and eighty. When the heart's action is accelerated by motion or by exercise, the respirations are accelerated in the same ratio; and when its action becomes slow again, the respirations becomes also less frequent.

Mr. Hutchinson* has given a table of the number of respirations in a minute in 1714 healthy adult males, when in the sitting posture; from which it appears that the majority make between sixteen and twenty-four respirations in a minute: of these, a large number make twenty; and in the greater number there were four beats of the heart for one inspiration. The following table, given by Dr. Guy, shows the average proportions of the pulse to the respiration in 238 experiments; the pulse varying from 44 to 85 beats, and the respirations from 15½ to 20½: the majority of the experiments were made in the sitting posture:—

No. of Observations.	Pulse.	Proportion.
8	45-50	2.75 to 1
37	50-55	3.05 to 1
50	55-60	3.31 to 1
50	60-65	3.52 to 1
50	65-70	3.59 to 1
27	70-75	3.82 to 1
12	75-80	4.18 to 1
4	80.85	4.31 to 1

The following tables† gives the average result of some experiments made on himself by Dr. Harden, in order to determine the ratio of the pulse to the respiration in different postures:—

	Standing.	Sitting.	Lying.
Pulse	80	70	66
Respirations	16	14	12

According to Mr. Parrot,‡ the frequency of the heart's action increases in a corresponding ratio with the elevation above the level of the sea. Thus—

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* Med.-Chir. Trans., vol. xxiv.

† Amer. Jour. of Med. Sciences, vol. v. 1843.

‡ Muller's Physiology, vol. i.

When the pulse at the level of the sea was				.	70
at	3282 feet above its level it rose to			. . .	75
at	4875	"	"	"	82
at	6500	"	"	"	90
at	8125	"	"	"	95
at	9740	"	"	"	100
at	13000	"	"	"	110

The cause of the heart's action increasing in frequency according to the elevation above the level of the sea, appears to lie in the lungs rather than in the heart. We know that as the air becomes more rarified the respirations become more frequent: the heart, therefore, is only indirectly excited in consequence of the increased frequency of the respiration, and the ratio between the number of respirations and the number of pulsations of the heart is, probably, the same at each level.

Several pathological conditions have great influence upon the frequency of the pulsations of the heart: in but a few it becomes slower,—in the large majority of diseases it becomes more rapid than natural; while in certain morbid states the ratio between the number of the respirations and the number of pulsations of the heart becomes altered. These are matters, however, for subsequent consideration.

Rapidity of the passage of the blood through the system.—The rapidity with which the blood passes through the system can be estimated if the amount which is transmitted into the aorta at each systole of the left ventricle is known, and if the entire quantity of blood contained in the vessels is determined—the number of pulsations of the heart being given. Thus it has been estimated that the whole amount of blood contained in the vessels is about twenty-eight pounds; and that an ounce and a half is expelled at each systole of the left ventricle. If, then, the heart of the adult beats seventy-five times in a minute, 112½ ounces, or a little more than seven pounds of blood, would pass through the ventricle in a minute: in four minutes the entire twenty-eight pounds would pass through the heart; and in every hour it would pass through it fifteen times.

Force with which blood is propelled by the left ventricle—The force with which blood is expelled by the left ventricle has been variously stated by physiologists. Hales made many experiments, with the object of determining this point; he estimated the force with which the blood is propelled into the aorta at four pounds six ounces: "seven feet and a half being the height to which he supposed the blood would rise in a tube connected with the large arteries." M. Poiseuille invented an instrument for measuring the momentum of the current of blood in the large arteries, to which he gave the name of *hemadynamometer*, from which he estimated the force with which the blood is propelled into the aorta at four pounds three ounces; "a result which agrees remarkably with that obtained by Hales."

In employing compression for the cure of external aneurism, I have found that the weight which was sufficient to diminish materially, or to check the current in a large artery, differed considerably in different subjects; in some instances a pressure equal to four pounds upon the femoral artery in the groin was sufficient to check the pulsation of a popliteal or femoral aneurism; in the majority of cases a pressure equal to six or eight pounds was necessary to effect the same object; while sometimes a weight of ten pounds was requisite.

Mechanism of the action of the valves of the heart—Auriculo-ventricular valves—Sigmoid and semilunar valves—Safety valve function of the tricuspid valve—Impulse of the healthy heart—Mechanism by which the impulse is produced—Sound sometimes caused by the impulse of the heart—Seat of the impulse—Alteration of the impulse in inspiration and expiration—Double impulse of the healthy heart.

MECHANISM OF THE ACTION OF THE VALVES OF THE HEART.

The valves of the arterial orifices of the heart are, Hunter[*] observes, "inelastic membranes, having no action within themselves;" these valves are raised or depressed simply by a mechanical process, which can be effected equally well in the dead as in the living heart. The valves at the auriculo-ventricular orifices, on the other hand, being connected to the parietes of the ventricles by muscular columns, the shortening or lengthening of which are essential to the due performance of their valvular functions, cannot be made to act perfectly in the dead subject.

Auriculo-ventricular valves.—It has been already stated that the auriculo-ventricular valves are composed of curtains, of tendinous cords connected with these curtains, and of fleshy columns, which are attached by one extremity to the tendinous cords, and by the other to the parietes of the ventricle. Anatomists, in describing the mode of action of these valves, state, that one use of the fleshy columns is, by their contraction, to draw down the curtains of the valve, and so to approximate the edges of the valves, and close the orifice. It must, however, be recollected that, at the period at which the auriculo-ventricular valves close their orifices, viz., at the very commencement of the ventricular systole, the ventricles are full of blood: hence the contraction of the carneæ columnæ, and the tension of the tendinous cords, instead of approximating the edges of the valves and closing the orifices, would be rather to hold the curtains of the valve open, because the fleshy columns all run, more or less, towards the apex of the heart, to be inserted into the parietes of the ventricles.

It was long since remarked by Senac, that "in order for the auriculo-ventricular valves to close their respective orifices, the apex of the ventricle must be approximated to the base, as in the dilated state of the ventricle they are too short to do so." Hunter, in describing these valves, oberves—" the tendinous cords are inserted into muscular columns, the intention of which is very vident: for if they had gone the whole length n the form of tendon, they would have been too ong when the ventricle contracted, and the valves n such a case would have allowed of being pushed nto the auricles; but the carneæ columnæ keep he valves within the ventricle in its contracted tate." The use of the carneæ columnæ appears, hen, simply to be to adapt the valve to the altered tate of the ventricle during its systole and distole, and to prevent them from being reversed during the systole. When the apex of the ventricle is approximated to the base during the ventricular systole, if these valves were not provided with muscular columns which shorten as the ventricle shortens, the valves would be reversed; but from the direction of the fleshy columns, as the ventricle is shortened, the carneæ columnæ must be shortened at the same time.

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[*] Treatise on the Blood.

The use of the carneæ columnæ therefore evidently is, not to close the curtains of the valves: this is effected by the mechanical operation of the blood contained in the ventricle, as was long since shown by Lower, though recently advanced as a novel view by Baumgarten and Hamernjk. The blood which enters from the auricle during the ventricular diastole, falls by its own gravity to the bottom of the ventricle, the curtains of the valve are thus floated towards the base of the ventricle; the auricular systole then impels a small additional quantity of blood into the ventricle: the systole of the latter instantly ensues, and the curtains of the valve are applied and pressed together so as to close the orifice. Hence the blood which enters the ventricle becomes in a great measure the means by which the auriculo-ventricular valves are closed, and regurgitation prevented.

The curtains of the mitral valve in closing the orifice, " meet (Mr. T. W. King* observes) not only by their free edges, but by the marginal portions of their auricular surface; and thus on each curtain there is a broad line or surface of contact situated just within the auricle, or between it and the ventricle, varying in breadth, regularity, and distinctness." These he terms " the surfaces of contact or attrition:" very slight traces of them are discoverable in the healthy adult heart. " The surfaces of contact (he adds) are liable to become attenuated or even perforated by disease, and this is the explanation of many cases of atrophy of the curtains of this valve: an appearance which is seldom observed in the curtains of the tricuspid valve."

As soon as the ventricular systole ceases, the muscular fibres forming the walls of the ventricles, and the carneæ columnæ of the auriculo-ventricular valves, are relaxed: the curtains of these valves, no longer pressed upwards by the blood, separate from one another: this fluid enters in a full stream from the auricle, until its systole again ensues, when the phenomena mentioned before are repeated.

Sigmoid and semilunar valves.—The mechanism by which the valves at the orifices of the aorta and pulmonary artery close their respective orifices, is, as I have said, simply mechanical; behind each of these valves a little sinus (sinus of Morgagni) is seated, into which the blood readily insinuates itself as the ventricular systole ceases; and the valves are pressed down by the weight of the column of blood above. Without some provision of this kind, the blood could with difficulty get behind those valves, and regurgitation into the ventricles of necessity would frequently take place during the diastole of these cavities.

When the ventricular systole ensues, the sigmoid and semilunar valves are elevated and pressed against the sides of the aorta and pulmonary artery by the blood in its passage into these vessels; and here again another use of the sinuses of Morgagni comes into operation—viz. to afford a space for the valves to lie back in at this period of the heart's action, and thus to render the interior of the aorta and pulmonary artery perfectly smooth and even at the part. If there had not been some provision of this kind, these valves would project, in a certain degree, upon the interior of the artery, render this portion of the vessel uneven, and of course increase the friction between the blood and the interior of the artery in its passage through it. When the aortic valves become rigid from disease, they cannot lie back in their normal position during the ventricular systole, and not only is the blood in its passage from the ventricle into the aorta impeded, but regurgitation into the ventricle is, as we know, frequently permitted.

The little fibro-cartilaginous bodies (corpora Arantii) which are situated near the centre of the free margin of each of the semilunar valves, are supposed by some anatomists to serve the purpose of filling up the small space, which they suppose would be left in the centre, when the valves fall down; but as these little bodies are not seated at the very margin of the valves, they could scarcely effect this object, which indeed is unnecessary, because it has been shown by Dr. Duncan that the arterial valves, particularly those of the aorta, overlap one another slightly where they meet: indeed, Mr. King says " the surfaces of contact are not unfrequently equal in extent to the remainder of the curtain of the valve." The use of these little bodies evidently is to strengthen the valves, by serving as points of insertion for the tendinous bands which enter into their formation. Without this provision these valves would be very liable to become reversed.

Safety-valve function of the tricuspid valve.—Mr. Hunter,* in describing the action of the tricuspid valve, observes—" I have reason to believe that the valves in the right side of the heart do not so perfectly do their duty as those of the left; therefore we may suppose it was not so necessary." Mr. Adams,† after quoting the foregoing remark of Hunter, observes—" This circumstance in my opinion, has not been sufficiently noticed, nor the influence that such a structure may have on the circulation in its natural or morbid state, considered. I look upon this difference in the valves of the right and left side of the heart to be a natural provision to allow of a partial reflex into the right auricle on those occasions when from any cause the passage of the blood through the arterial opening is retarded. Such a provision was absolutely necessary in the right or pulmonary ventricle, as various natural causes must momentarily retard the passage of blood through the lungs.

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* Guy's Hospital Reports.

* Treatise on the Blood.

† Dublin Hospital Reports, vol. iv.

More recently, Mr. King,* in an elaborate paper on "the Safety-valve Function in the Right Ventricle," has entered at length upon the subject, and pointed out the mechanism in the construction of this valve by which he considers regurgitation to be permitted. In the same communication he has given a minute description of the tricuspid valve, and of the manner in which its fleshy columns are connected with the ventricular walls. The fleshy columns of the anterior and right division of this valve are principally inserted (he observes) into the yielding wall of the ventricle; those of the posterior division into the septum: the latter is consequently more fixed. The anterior and right divisions of the valve he calls "the curtains of distension," and he considers them the agents by which the orifice is opened so as to permit of regurgitation in the auricle.

In the normal state of the tricuspid valve, and of the orifice of communication between the right auricle and ventricle, and when the ventricle is only moderately distended, regurgitation is not permitted: it does, however, occur if the right ventricle at the commencement of its systole is much distended: this may occur in a state of health when the heart's action is increased by any cause; but it subsides when this ceases, and the mechanism by which it is brought about is sufficiently simple.

In describing the tricuspid valve I mentioned that a single fine tendinous cord, not springing from any fleshy column, is frequently found to be attached by one extremity to some part of the anterior curtain of this valve, either near the base of its carneæ columnæ, or near where the latter join the tendinous cords; the opposite extremity is inserted into the right or yielding wall of the ventricles, or into the base of the fleshy columns of one of the other divisions of the valve. Its use apparently is to prevent the anterior curtain of the valve from being applied to the orifice when the ventricle is much distended; and the more the cavity of the ventricle is distended, the more open will it keep this valve; while, when the ventricle is not much distended, it will in no way interfere with the perfect action of the valve.

While the tricuspid valve, under the circumstances mentioned, permits regurgitation, the mitral valve always perfectly closes the left auriculo-ventricular orifice, and never, unless when it or the orifice has undergone some morbid change, permits regurgitation. Indeed, the effect of disease upon these two valves or orifices is generally quite the reverse: in the majority of cases in which the mitral valve or orifice is altered from its normal condition, the opening is contracted; while the tricuspid orifice, on the other hand, is more frequently found to be dilated; and the phenomenon known as "jugular pulsation" usually attends the latter state.

"The mitral valve (Mr. Adams* observes) so perfectly closes the aperture of communication between the left auricle and ventricle, that in the natural state no reflux whatever is admitted: this, so useful at the right side of the heart, would have been not only useless, but injurious, at the left side of the organ, as we find the general arterial system at all times equally ready to receive the blood during the systole of the left ventricle; and if the mitral valve did not close the left auriculo-ventricular aperture, a great deal of the force of the aortic ventricle would be wasted, whereby it would be incapable of moving the mass of blood which was destined to fill the arterial system." "Pathologists, in looking (he adds) to the different nature of the lining membrane at the two sides of the heart, as a means of explaining the greater liability of the left side to disease, have perhaps too much overlooked this circumstance—that while, from the unyielding nature of the mitral valve, all reflux into the auricle is prevented, from this very cause, which renders it effective in the circulation, is it exposed to more frequent injury, from which organic disease may arise, and the ventricle to which it belongs becomes more liable to be ruptured by its own efforts."

Impulse of the healthy heart.—The impulse of the heart accompanies the systole of the ventricles and the first sound of the organ, and has its cause in the apex of the heart coming in contact with the parietes of the thorax between the cartilages of the fifth and sixth left ribs The mechanism by which the impulse is produced was long a disputed point, and various have been the theories advanced by physiologists to explain it: even the period of the heart's action at which it occurs has been the subject of difference of opinion.

Thus it was at one time maintained that the impulse occurred during the diastole of the ventricles; and this opinion appeared to derive confirmation from the fact that when the heart of the frog is exposed (which will continue to pulsate for a considerable time after being laid bare,) the ventricle, during its diastole is seen to expand, and to approach the parietes; while during the systole the apex is simply approximated to the base. In this animal, therefore, the heart approaches the parietes during the diastole, not during the systole of the ventricle, and any impulse which is given must be at the period of the ventricular systole. An experiment was performed by Oesterreicher,† which consisted in removing the heart of the frog from the body, and laying upon it a substance sufficiently heavy to press it flat, and yet so small as not to conceal the heart from view. He states that during the systole of the ventricle the weight was raised, but that during its diastole the heart remained flat. This experiment has been quoted by Müller and others, to prove that the diastole of the ventricles is not a muscular act, in ignorance apparently of the foregoing peculiarity in the action of the heart in this animal. In warm-blooded animals, however, experiments and observations repeated over and over again have proved that the impulse occurs at the period of the ventricular systole, and that it is due to the apex of the heart coming in contact with the parietes of the chest.

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* Guy's Hospital Reports, vol ii.

* Dublin Hospital Reports, vol. iv.

† Muller's Physiology, vol. i.

Mechanism by which the impulse of the heart is produced.—It will not be necessary to delay to notice the various theories which have been advanced in order to explain the mechanism by which the impulse of the heart is produced: the majority of these are founded on erroneous views. It will be sufficient to observe, that during the ventricular systole the walls of the ventricle become more convex upon the surface, the apex of the heart describes a spiral motion from behind forwards, and from right to left: in describing this spiral movement, the apex glides obliquely upon the pericardium, is approximated to the base, comes in contact with the parietes of the thorax in the intercostal space between the cartilages of the fifth and sixth ribs, and thus causes the impulse. Indeed, this part of the heart is naturally so close to the parietes of the chest that no tilting forward of its apex is necessary to produce the slight shock felt at this period.

It was the received opinion until within a few years, that during the diastole of the ventricles the heart receded from the parietes of the chest, and that the impulse was produced by a blow, or shock given to the ribs by its apex, during the systole. Harvey, Haller, Senac, and Hunter, may be quoted as authorities for this theory. The experiments which have been performed upon animals of late years, and the examination of the action of the organ in cases of ectopia of the heart, have, however, shown that this theory has no foundation, and that the heart "does not suffer any changes in consequence of its own efforts (exclusive of the movements of the lungs and diaphragm) except in its shape and size, in the thickness and tension of its parietes, and in the capacity of its cavities," which are quite sufficient to produce the slight shock felt when the hand is laid on the parietes of the chest.

M. Ritter has recently advanced this as a novel doctrine, in ignorance probably of the results of the experiments of the "Committees of the British Association." His experiments are entirely corroborative of those previously made. "The portion of the heart's surface (he observes) which is in immediate relation to the walls of the chest, is at all times in close contact with them; and it is impossible that in any of its motions it can act so as to withdraw itself from the thoracic walls, or so as to leave a space between them." "Being thus fixed, therefore, it follows that, when the heart contracts and assumes a more globular form, it will exert its distending force on the yielding intercostal spaces against which it rests, and will thrust them forwards, so as to produce the impulse. This distending force cannot be exerted with any effect against the unyielding ribs or their cartilages; and, consequently, the impulse is not perceived by the finger placed over the cartilages of the fourth, fifth, or any other rib. If the impulse was caused by an actual stroke or blow of the heart against the walls of the chest, it would be perceived on these parts and on the sternum as clearly as it is in the intercostal spaces, and every person would feel the impulse of his own heart just as a pregnant woman feels any violent movements made by the fœtus in utero."

Sound sometimes produced by the impulse of the healthy heart.—Although in the healthy subject, when the circulation is tranquil, and the heart's action is normal, no sound is produced by the impulse, yet it occasionally happens that when the same heart is excited to increased action,—in other words, when palpitation ensues, whether the cause be mental emotion or corporeal exertion, but particularly the former,—the apex of the heart does come in contact with the ribs, the patient feels the blow or shock produced by the impulse of his own heart; and this is accompanied by sound, which of course will be heard at the period of the first sound of the heart, and will modify it in a certain degree or add to it. Under such circumstances the first sound of the heart becomes loud and ringing, and in diseased states it is sometimes so intense as to be audible without applying the stethoscope, and may be heard at a short distance from the patient. This point will be again alluded to when we come to consider the abnormal conditions of the heart.

Seat of the impulse of the heart.—The point at which the impulse of the heart is felt in the healthy male is the intercostal space between the cartilages of the fifth and sixth ribs upon the left side, to the sternal side of the nipple, and about two inches below this point. In the female, owing to the habitual wearing of stays, the impulse is usually a little higher up—viz. between the cartilages of the fourth and fifth left ribs; and in the latter months of pregnancy, for an obvious reason, it is perceived still higher up, and the apex is pushed more to the left side.

The impulse of the healthy heart is naturally slight; it is more marked in the erect than in the recumbent position, because in the latter position the heart, by its own weight, recedes slightly from the parietes of the chest. For the same reason the impulse becomes more distinct if a person leans forward, and more indistinct if he lies upon his right side. In the erect posture the impulse is said to be slightly lower than in the recumbent posture; but the difference, if any, is very trifling. In very fat persons the impulse is scarcely perceptible to the eye or hand; in very lean persons it is very obvious to both. When the lungs are largely developed they will overlap the heart more than usual; when the lungs are small, less of the heart will be covered by these organs: in the latter case, therefore, the impulse will be better marked than in the former.

Alteration of the impulse in inspiration and expiration.—In inspiration, particularly on a full inspiration, the impulse of the apex of the heart will be felt lower down than natural, as low as between the cartilages of the sixth and seventh ribs, or, in the epigastrium, between the line of the xyphoid cartilage. This is partly owing to the connection of the heart with the lungs, and partly to the connection of the pericardium with the diaphragm. On a full inspiration the lungs expand from above downwards, as well as from before backwards; and, according to Dr. Sibson, from the manner in which the pulmonary veins are joined to the left auricle, the heart is drawn down by the descent of the lungs. The principal cause of this descent of the heart in inspiration appears to lie rather in the intimate connection of the pericardium with the central tendon of the diaphragm; as the latter descends it must bring with it the heart; and from the connection of the inferior or ascending vena cava with the diaphragm, it must follow the movements of the latter, and draw down the right auricle. On a full inspiration, the impulse, in addition to being lower down, will be less marked than natural, because the lungs, when fully inflated, meet so as almost to cover the heart, and prevent its apex from coming in contact with the parietes of the thorax.

On a forced *expiration*, on the other hand, owing to the ascent of the diaphragm, the impulse of the heart is felt higher up—viz. on a line with the space between the cartilages of the fourth and fifth ribs on the left side; it is likewise more marked than natural, because the heart is less covered by lung. The point at which the impulse of the heart is felt is altered in some diseases of this organ, or of the lungs, or pleura, as well as in diseases of the abdominal viscera. These matters will, however, be considered when we come to describe the diseased states of the heart.

Double impulse of the healthy heart.—The impulse of the healthy heart has been almost always described as single; Magendie,[*] however, who attributes the first sound of the heart to the shock of the apex during the ventricular systole, lays it down that the second sound is due to the shock given by the ventricles to the parietes of the thorax during their diastole." The ventricles in dilating (he observes) in a great measure under the influence of the rapid influx of the blood, give a shock to the anterior parietes on the right side of the thorax, and thus produces the second clear sound." Dr. Sibson,[†] in his valuable essay upon the "Changes in the Situation of the Internal Organs," observes:—"A second impulse is often felt in persons whose lungs are diminished, and whose great vessels come close to the sternum. This is synchronous with the second sound, and must, I conceive, be due to the sudden springing forwards of the walls of the right ventricle after the systole." In the year 1848, in a communication[*] upon the subject of "Aneurism of the Aorta," made to the Surgical Society of Ireland, I called attention to the fact that the impulse of the healthy heart, when the organ is acting vigorously, is double, not single.

The impulse of the healthy heart, I observed upon that occasion, has been always described as single, just as that of aneurism of the arch of the aorta was supposed to be. If we carefully examine this organ, however, when it is beating vigorously, we shall find that a second but slighter impulse is perceptible, which quickly succeeds the other; and on applying the stethoscope we shall find that this second impulse accompanies the second sound of the heart: it appears as if the agency which gives rise to the second sound was capable of communicating a distinct sensation to the hand or stethoscope.

In the healthy heart the second impulse is scarcely felt, unless the organ beats vigorously; when the ventricles are somewhat hypertrophied, and their cavities somewhat dilated, the second impulse becomes better marked; when this has arrived at an extreme degree it becomes very evident, and constitutes then the "back stroke of the heart," or the diastolic impulse. This diastolic impulse, except in cases of disease, is never so strong as to be perceptible to the eye, but is readily distinguished when the ear is applied to the stethoscope laid upon the præcordial region. It is perceived at the same part of the chest as the systolic impulse, and is more marked the larger the surface of the heart uncovered by lung, and the stronger the action of the organ.

With respect to the cause of the diastolic impulse, Dr. Sibson[†] observes—"The second or diastolic impulse, which is felt between the second and third, and sometimes between the first and second costal cartilages, is neither more nor less than a sign that the upper part of the right ventricle, and the origin of the pulmonary artery, over which it is felt, are in contact with the walls of the chest." "This diastolic impulse, which is synchronous with the second sound, is a physiological, not a pathological phenomenon, and is due to the sudden return forward of the walls of the right ventricle, and of the origin of the pulmonary artery, immediately after the systole; the parts in question then impinge with a short sharp tap on the left second and third costal cartilages, and on the space between them."

When describing the motions of the heart, we saw that during the ventricular diastole the apex of the heart recedes from its base; the organ becomes elongated, the ventricles increase in all their dimensions, and the hand grasping the heart is forcibly opened. Now, when we consider how closely the anterior surface of the ventricular portion of the heart lies to the parietes of the thorax, there is no difficulty in understanding how an impulse may be communicated during this movement equally as during the ventricular systole ; it appears only surprising that it should have been so very generally overlooked.

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[*] Elements of Physiology.

[†] Trans. of Prov. Association, vol. xii.

[*] Dublin Medical Press, vol. xix.

[†] London Journal of Medicine, vol. i.

Sounds of the heart—Normal limits and intensity of the heart's sounds—Mechanism by which the sounds of the heart are produced—Theories of the cause of the first sound—Theories of the cause of the second sound—Theory of the sounds of the heart most generally received—Remarks on the foregoing theory—Theory of friction between the blood and the parietes of the orifices of the heart as a cause of the sounds—Objections to the theory of valvular tension as a cause of the first sound—Objections to the theory of muscular contraction as a cause of the first sound—Objections to the theory of the recoil of the blood upon the arterial valves as a cause of the second sound—Pathological evidence in favour of the theory of friction between the blood and the parietes of the orifices of the ventricles as a cause of the sounds of the heart.

Sounds of the heart.—If the ear, either with or without the stethoscope, is applied to the præcordial region in a healthy subject, two sounds are heard, which succeed each other quickly, but are readily distinguished from one another, and are followed by a pause or interval of repose ; after which the same phenomena are repeated. If the heart's action is very slow, a short but distinct interval may be recognised between these two sounds, and the pause or interval of repose is longer : if, on the other hand, the action of the heart is very quick, the sounds follow one another with such rapidity that there scarcely appears to be any interval of repose.

The sound which occurs first in order after the pause is termed the first sound of the heart, sometimes the systolic sound ; that which follows it is termed the second sound, sometimes the diastolic sound. The first of these sounds, compared with the second, has a dull character and its duration is longer ; the second sound is short and clear, and was compared by Laennec to the lapping of a dog, or to the falling back of a valve. The first sound is heard at the period of the ventricular systole, and for this reason has been named the systolic sound : it is synchronous with the impulse of the heart, and with the pulse. The second sound occurs at the period of the ventricular diastole, and for this reason is sometimes termed the diastolic sound : it immediately precedes the pause or interval of repose.

Both these sounds are readily distinguished at every part of the præcordial region : both are well marked at that part of this region where a dull sound is elicited by percussion ; that is, where the heart approaches most closely to the parietes of the chest. Cruveilhier, in his examination of an infant born with her heart exposed, ascertained that both sounds increased in intensity from the apex towards the base of the heart, and that the maximum intensity of both sounds was at the same place, and *vice versâ* : "hence (he observes) it is at the base of the organ we are to look for the cause of these sounds." Both sounds of the heart are usually well marked at the point where the apex is felt to beat, as well as over the base of the ventricles. The first sound is generally considered to have its greatest intensity on a plane lower than the second ; and M. Pigeaux, from this circumstance, has proposed the name *inferior* sound for the first, and *superior* sound for the second. The sounds developed at the orifices of the right ventricle are better heard towards the right edge of the sternum ; those developed at the orifices of the left ventricle are better heard towards the left edge of this bone ; and the American experimenters determined that the ventricular systolic sound on the right side was sharper and clearer than that on the left, which was more dull and prolonged.

Normal limits and intensity of the heart's sounds.—There is considerable difference even in health in different individuals in the intensity as well as in the extent over which the sounds of the heart are audible : in some subjects they are limited to the præcordial region, and are comparatively feeble there ; in others they extend much beyond the præcordial region, and are loud there. Whether the sounds are feeble or the contrary, and whether they are limited to the præcordial region or not, will depend upon a variety of circumstances—as the intensity of the sounds themselves, which is different in different subjects ; as the coverings of the chest are thick or thin ; as a larger or smaller surface of the heart comes in contact with the parietes ; as the lungs are largely developed and overlap the heart, or the contrary ; and as the chest is capacious or narrow.

Dr. Latham,* in his admirable lectures, speaking of the "natural limits of the heart's sounds," observes—"It is a preliminary point which some have thought most important to be determined with precision : but no good ever comes from pretending to more precision than the thing itself admits of ; and I am sure this matter does not admit of much. The præcordial region, it has been said, defines it ; but surely the second sound always exceeds that limit, and is audible also in the course of the aorta, of the pulmonary artery, and of the carotids." "With respect to the first sound, I should be at a loss to mark the exact space within which healthy proportion and healthy structure always required it to be heard, and in neither more nor less. There are so many circumstances, some consistent with health in the largest sense, and some exclusive at least of its disease, which make the systolic sound of the heart more or less extensively audible, that (I am persuaded) two healthy persons would not easily be found in whom it would be heard exactly within the same thoracic space. Whether a man be fat or lean will always make a great difference. In the one it will be kept within the præcordial region ; in the other it will be carried beyond it. Fat is so bad a conductor, that, where it greatly abounds, it will restrict the sound to less than the entire præcordial region, even to a very small part of it; so that you will not be able to hear the heart further than you can feel its impulse, or further than its apex. But mere skin and bone are such good conductors, that in very thin persons the sound will be spread very far beyond the præcordial region, and will be heard at any part of the chest to which you apply your ear."

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* Lectures on Diseases of the Heart, vol. i.

"I believe that in most persons of what is called a nervous temperament, even when they are under no conscious excitement, the heart's sounds are to be heard beyond it; and I believe, too, that in persons of this temperament the heart's sounds are apt to be of a higher intonation One condition, no doubt, is the result of the other. In proportion as the sounds of the healthy heart are more highly intonated, they acquire a greater audible extent. The louder they are, the further you hear them; and it is the very characteristic of a nervous heart to have its sounds both highly intonated and extensively audible."

Mechanism by which the sounds of the heart are produced.—We come now to the most difficult part of the subject—the cause of the sounds of the heart, or the mechanism by which they are produced: it is the one upon which the greatest difference of opinion has existed among physiologists and anatomists, and for the explanation of which the greatest number of hypotheses have been advanced.

Theories of the cause of the first sound.—It must be borne in mind that at the period at which the first sound of the heart is heard—

1st. The muscular walls of the ventricles contract, and the cavity of the ventricles is diminished.

2dly. The mitral and tricuspid valves close their respective orifices.

3dly. The blood is propelled with considerable force into the aorta and pulmonary artery.

4thly. The valves at these orifices are suddenly elevated; and

5thly. The impulse of the apex of the heart against the parietes of the chest takes place.

Now the first sound of the heart must obviously be due to one or other of these acts, or to a combination of them; and it will be necessary to notice shortly the theories which have been advanced under this head.

As it has been completely proved that the first sound of the heart accompanies the ventricular systole, any theory founded upon a different order of succesion of the heart's motions must be rejected,—such as, that it is due to the systole of the auricles, or to the diastole of the ventricles, or to the systole of the left ventricle alone, the second sound being attributed to the systole of the right; because it is well known that the two ventricles contract simultaneously; that the ventricular diastole occurs at the period of the second, not of the first sound; and that the auricular systole does not take place at the period of the first sound of the heart.

The theories which have been advanced in order to explain the mechanism by which the first sound of the heart is produced, may, for convenience sake, be considered as the cause is supposed to be extrinsic to or intrinsic to the heart. Thus, under the first, it has been attributed to the impulse of the apex against the parietes of the chest; under the second head, it has been attributed to muscular contraction—in other words, to the successive shortening of the muscular fibres of the parietes of the ventricles. This is the oldest theory: it was adopted by Harvey, Haller, Senac, Bichât, and Corvisart. 2dly. To the sudden closure of the auriculo-ventricular valves. 3dly. To the friction of the blood against the parietes of the interior of the ventricles, or of the orifices of the large arteries. 4thly. To the collision of the opposite internal surfaces of the ventricles at the conclusion of the systole. 5thly. To the straightening or elevation of the sigmoid and semilunar valves, caused by the wave of blood transmitted by the ventricles; and, lastly, to two or more of the foregoing causes combined.

Theory of the sound being produced by the impulse.—Majendie is the principal supporter of the theory that the first sound of the heart is caused by the impulse communicated by the apex of the organ to the parietes of the thorax during the ventricular systole. This sound has, however, been distinctly heard in experiments upon animals where the anterior parietes of the chest were removed, and the heart fully exposed, as well as in infants labouring under ectopia cordis.

Theory of Muscular Contraction.—Those who refer the first sound of the heart to the muscular contraction of the walls of the ventricles include two phenomena under this head—viz, "the sound of muscular extension or tension," and the "bruit musculaire" or "rotatoire." Dr. Hope refers this sound essentially to muscular extension, which, according to him, is "a loud, smart sound, produced by the abstract of sudden jerking extension of the already braced muscular fibres at the moment that the auricular valves close." "It is (he observes) essentially different from the bruit musculaire, since it may be produced in a dead muscle, and may attain a high degree of loudness or sharpness; whereas bruit musculaire can only be produced in a living muscle, and is never more than dull and subdued." Other physiologists suppose the cause of this sound to lie exclusively in bruit musculaire. Dr. Blakiston is of opinion that it is caused by "the friction of the muscular fibres of the walls of the ventricles *inter se*."

Theory of the collision of the opposite walls of the ventricles.—By some physiologists the first sound of the heart has been attributed to the collision of the opposed internal surfaces of the ventricles at the conclusion of the systole; but as it is a doubtful point whether the ventricles completely empty themselves during their systole, and as it is quite certain that no such collision of the opposite walls of the ventricles takes place, this theory may be dismissed.

Valvular theory.—By many physiologists the first sound of the heart has been attributed to the sudden tension or closure of the mitral and tricuspid valves which occurs during the ventricular systole. Dr. Billing in England, and M. Rouannet in France, are the most distinguished advocates of this theory. But, as the auriculo-ventricular valves close their respective orifices at the very commencement of the systole of the ventricles, this act is certainly not capable of producing the prolonged first sound of the heart. According to M. Cruveilhier, on the other hand, the first sound is due not to the closure of the mitral and tricuspid valves, but to the straightening or elevation of the sigmoid and semilunar valves, caused by the wave of blood transmitted by the ventricles.

Theories of the motion of the blood.—According to M. Pigeaux, the first sound of the heart is due to the friction of the blood against the walls of the ventricles, and of the orifices and parietes of the large arteries, during the ventricular systole. According to M. Gendrin, it is due to the "vibrations which result from the sudden change of form which the blood experiences during the ventricular systole." According to others, to the collision of the particles of the blood against each other, and against the walls of the ventricles, during the systole.

Theories of the cause of the second sound.—The second sound of the heart is heard at the period of the ventricular diastole; and it must be borne in mind that during this act—

1st. The muscular fibres of the walls of the ventricles are relaxed, and the ventricular cavities become enlarged.

2dly. The auriculo-ventricular valves are opened, and the blood passes from the auricles into the ventricles, through the mitral and tricuspid orifices.

3dly. The sigmoid and semilunar valves are pressed down by the column of blood above them, and the aortic and pulmonary orifices are closed.

The second sound of the heart must, therefore, have its cause in one of these acts, or in a combination of them; and any theory founded on a different order of succession of the heart's motions cannot be correct, as that this sound is due to the auricular systole (Laennec,) because the auricles contract immediately before the ventricles; or that it is due to the auricular diastole (Beau,) because no sound is produced during this act; or that it is due to the systole of the right ventricle (Piorry,) because both ventricles contract simultaneously.

The theories which have been advanced to explain the mechanism by which the second sound of the heart is produced, may, like those of the first sound, be considered under the head of causes extrinsic to the heart, and causes intrinsic to it. Thus Majendie attributes the second sound to the impulse communicated by the ventricles to the parietes of the chest during their diastole; and Dr. Turner, to the falling back of the heart against the pericardium at the moment of the ventricular diastole. But the second sound was heard in experiments upon animals where the ribs and sternum were removed and the pericardium laid open, as well as in infants labouring under ectopia cordis.

Those who refer the second sound to causes intrinsic to the heart, consider that, like the first sound, it may have its cause in muscular action, in valvular action, or in the motions of the blood. Thus by some this sound has been supposed to be due to the stretching of the muscular fibres of the ventricles in their diastole; but the muscular fibres are relaxed during this period of the heart's action. It has been also attributed to the rush of blood through the auriculo-ventricular orifices during the ventricular diastole; to the collision of the blood against the parietes of the base of the ventricles during their diastole; to the sudden closure of the sigmoid and semilunar valves at the moment of the ventricular diastole; or to the recoil of the column of blood in the aorta and pulmonary artery upon the sigmoid and semilunar valves at the moment that the ventricles dilate.

Theory of the sounds of the heart most generally received.—The theory of the mechanism by which the sounds of the heart are produced which is most generally received, is as follows:—

First sound.—The first sound of the heart is regarded as a compound sound, partly valvular and partly muscular, the valvular portion being its first and loudest part, and being due to the sudden tension or closure of the mitral and tricuspid valves. The muscular portion of the sound, which is dull and prolonged, is supposed to be caused by the contraction of the muscular fibres of the walls of the ventricles, and to be due essentially, according to Dr. Hope, to "muscular extension," but receiving a "prolongation, and possibly an augmentation, from bruit musculaire;" according to others, to bruit musculaire alone, or to friction between the fibres of the muscular tissue of the ventricles.

That this sound is partly due to the sudden closure of the mitral and tricuspid valves, is considered to be proved "by the sound being loudest over the parts of the ventricles nearest to the auricular valves;" 2dly, "when valvular extension was prevented by holding the mitral valve open (in experiments upon animals,) this greatly diminished the first sound;" 3dly, whenever the auricular valves were destroyed, or the blood evacuated out of the ventricles, the sound became dull and obscure;" and lastly, by the character of the first sound in dilatation with attenuation of the ventricles, when it closely resembles the second sound.

That the first sound of the heart has its cause, likewise, in contraction of the muscular fibres of the walls of the ventricles, is considered to be proved by the "character of the sound,"—by its continuing during the entire systole—by its being still heard, although weaker in the heart of animals removed from the body,—"by its being heard, although modified in animals, when the auriculo-ventricular valves were prevented from acting, or when the blood was prevented from entering the cavity of the ventricles by pressing upon the orifices,"—"by the sound being louder over the surface of the ventricles than over the origin of the large arteries,—and finally, by the sound being loud and short, when the walls of the ventricles are thin; and dull and prolonged when its walls are thick;" because a thick ventricle, cæteris paribus, takes a longer time to contract than a thin one.

Second sound.—The second sound of the heart is supposed to be due either to the sudden closure of the valves at the orifices of the aorta and pulmonary artery, owing to the recoil of the blood upon them at the moment the ventricular systole ceases; or to the shock of the column of blood in the aorta and pulmonary artery, which recoils upon these valves at the moment of the ventricular diastole. This theory is supposed to be proved "by the second sound of the heart being loudest over the sigmoid and semilunar valves, and a little above them"—"by the sound ceasing in experiments made upon animals, when the reflux of the blood upon the semilunar valves was prevented by compressing the arterial orifices with the fingers"—and "by its being diminished when a semilunar valve in one artery was hooked up and replaced by a murmur from regurgitation when the same was done in both arteries."

The following experiment was made by M. Bouillaud, to prove that the second sound of the heart is caused by the reflux of the column of blood upon the sigmoid and semilunar valves. He attached one extremity of a short glass tube, of an inch bore, to the aorta immediately *below* the semilunar valves, and to its other end a bladder full of water. Another tube, four feet long, was connected with the aorta *above* the semilunar valves, the bladder was suddenly compressed at intervals, so as to jerk up the fluid, and each time that the pressure on the bladder ceased, and the column of liquid was allowed to fall back upon the valves, a sound very analogous to the second sound of the heart was heard.

A somewhat similar experiment was made by Dr. Corrigan, but with a different result. He removed the heart and ascending aorta of an ass, and then "tied it on the end of a leaden tube of a corresponding diameter, about five feet long; about two or three inches of the aorta then being free from the lower extremity of the tube. In this state, holding the sides of the aorta together below, he filled the tube with water, and then placing the thumb on the upper end, so as to close it, the fingers were withdrawn from the lower end, and the upper end still remaining closed, the external pressure of atmospheric air kept the two sides of the aorta below together, and no fluid escaped. The ear was then applied to the lower end of the tube, close to the aorta, and the thumb being suddenly withdrawn from above, the whole column of fluid came suddenly down, and distended the aorta and valves; and yet there was no sound whatever similar to the second produced." He then "attached a piece of sounding-board, to assist the ear, and the result was the same as before."

Remarks on the foregoing theory—The foregoing theory, it will be observed, omits from the elements capable of producing the sounds of the heart, all consideration of friction between the blood and the parietes of the orifices of the heart, in its passage into and out of the ventricles, during their systole and diastole. Yet when we come to describe the abnormal sounds heard in diseased states of the valves and orifices of the organ, we shall find that this very element, which is rejected as incapable of producing the normal sounds, is set down as the one which almost exclusively gives rise to the abnormal sounds of the heart. Now when we consider the force and rapidity with which the blood is propelled by the ventricles, particularly by the left, there can be no doubt that there is a considerable degree of friction between the blood and the parietes of the orifices through which it passes; and that this can scarcely happen without producing sound, appears evident, because even a slight impediment to the current of blood is sufficient to convert the normal first sound of the heart into a murmur.

Thus in experiments made upon large animals, when the calibre of the aorta near its origin was narrowed by pressing upon it during the ventricular systole the first sound of the heart was converted into a murmur. Again, if the stethoscope is applied over a large artery, a short, slight single sound is heard at each systole of the left ventricle; but, if pressure is made upon the vessel so as to diminish its calibre, a murmur will take the place of the normal sound. Again, the blood in its passage through the veins causes no sound appreciable to the ear: under certain circumstances, however, sound is developed in particular veins, when their coats are made tense, and when their calibre is diminished by pressure with the stethoscope. This sound is familiar to us as the venous murmur.

Now, in each of these instances, there is an obstacle or impediment to the passage of the blood and the increased friction, which necessarily ensues, is sufficient to convert the normal sound into a murmur. It seems probable, therefore, that abnormal sounds, are nothing more than exaggerated normal sounds, exaggerated because the friction between the blood and the parts through, or along which it passes, is increased; and if we admit, as the foregoing instances seem to prove, that normal sounds can be converted into abnormal sounds, simply by increase of friction, it seems not ununreasonable to conclude that both are developed by the same agency.

In addition, we know, that in aneurism springing from the arch of the aorta, a double sound is constantly audible, and this double sound remarkably resembles the double sound of the heart; so close indeed is the resemblance, that the second sound of aneurism in this situation is erroneously supposed by many to be the second sound of the heart transmitted to the aneurismal sac. We also know that the first, or the second, or both the aneurismal sounds, are not unfrequently converted into murmurs, which have precisely the character of the murmurs heard in cases of valvular disease of the heart.

Now, in aneurism, in this situation, we have simply a sac communicating with a large artery by a single orifice, which is constantly patent; the sac is traversed by the blood propelled at each systole of the left ventricle, and into it the blood regurgitates at each diastole of the ventricle; yet every variety of normal and abnormal sound developed in the heart, with its muscular walls and valvular apparatus, may be produced also in an aneurismal sac which has neither the one or the other. It is scarcely, therefore, unreasonable to conclude, that the agent which is capable of generating sound in the one case is capable of developing analogous sounds in the other; and that, as sounds almost precisely similar to those of the heart, in its healthy as well as in its morbid state, can be produced independent of valvular extension, or muscular contraction, the latter are not such essential agents in the production of the heart's normal sounds as is generally supposed.

Theory of friction between the blood and the parietes of the orifices of the heart.—From what precedes, it would appear that sounds in every respect analogous to the normal sounds of the heart may be developed independent of valvular action, or of muscular contraction; while we know that the normal sounds of the heart are readily converted into murmurs simply by increase of friction between the blood and the parietes of the orifices of the heart. Now, when we consider the rapidity and the force with which the blood enters and is expelled from the ventricles; and when we consider the amount of friction which must necessarily take place between this fluid and the parietes of the orifices of the heart, it seems not unreasonable to refer the normal sounds of the heart to this cause, rather than to valvular action or muscular contraction: the first sound to the friction between the blood and the parietes of the arterial orifices during the ventricular systole; the second sound to the friction between the blood and the parietes of the auriculo-ventricular orifices during the ventricular diastole.

First sound.—The first sound of the heart we know is synchronous with the ventricular systole: in this act, the blood, compressed by the contraction of the powerful muscular walls of the ventricles, is propelled with considerable force into the aorta and pulmonary artery, the sigmoid and semilunar valves of which are suddenly elevated. In the rapid passage of the blood from a wider to a narrower area, there must be considerable friction between this fluid and the parietes of the arterial orifices; quite sufficient, in my mind, to produce the prolonged first sound of the heart. This sound necessarily has a distinct character from the second sound of the heart, because the resistance to be overcome is so much greater, and the passage of the blood through these orifices is more gradual; it is likewise more prolonged, because sound must be developed during the entire period that the blood is passing from the ventricles into the large arteries: and the slower the action of the heart, the more prolonged will this sound be.

Second sound.—The second sound of the heart we know is synchronous with the ventricular diastole: during this act the muscular fibres of the ventricles are relaxed, the cavity of the ventricles enlarges, and the walls of the ventricles re-expand; the curtains of the auriculo-ventricular valves open, and there is a sudden influx of blood from the auricles through the auriculo-ventricular orifices. It is scarcely necessary to say that it is not the contraction of the auricles which propels the blood into the ventricles at this period of the heart's action; nor is the dilatation of the cavities of the ventricles the result of the entrance of the blood from the auricles, as some have supposed. It is not either necessary for the production of this sound that the diastole of the ventricles should be an active process like the systole; the ventricles being hollow muscles, the state of relaxation of their muscular fibres is a state of dilatation of their cavities: hence a vacuum would be created in them if the auricles were not at this period full of blood ready to supply them; but, as the latter had been filling during the whole period of the ventricular systole, this cannot happen. and the blood passes through the auriculo-ventricular orifices in a full and rapid stream, and with sufficient force to generate sound.

That the blood enters the ventricles with considerable force, would appear from what has been observed in experiments upon animals, as well as in the human subject. Cruveilhier says that, in a case of ectopia of the heart in an infant, when the organ was grasped with the hand during the ventricular diastole, it was violently and forcibly opened,—so much so, that he was at first under the impression that the diastole was the active state of the ventricles.

The second sound of the heart is much shorter than the first sound, because the relaxation of the muscular fibres of the ventricles in the diastole is rapid, and the motion is sudden and instantaneous. It has a different character from the first sound, because the blood has no impediment to overcome in entering the ventricles from the auricles.

Objections to the theory of valvular tension as a cause of the first sound.—It is said that the heart, being a muscular organ, and its orifices being each provided with a distinct valvular apparatus, the contraction of the muscular tissue of the ventricles, or the action of its valves, ought to be capable of producing sound. Now the first sound of the heart cannot have its cause exclusively in the sudden tension or closure of the auriculo-ventricular valves, because this act takes place at the very commencement of the systole; and the first sound is a dull prolonged sound, which persists during the entire systole. That any part of this sound is produced by valvular action seems to be doubtful, because the curtains of the mitral and tricuspid valves are floated towards the orifices by the blood which distends the ventricles; and, when the ventricular systole commences, the auriculo-ventricular orifices are mechanically closed by the pressure of the blood against the curtains of these valves.

Objections to the theory of muscular contraction as a cause of the first sound.—It remains, therefore, to consider how far the first sound is due to muscular contraction. This is supposed to be proved by the first sound having been heard in experiments upon animals when the organ was removed from the body and continued to contract, because there was then neither collision of the blood nor valvular action; but when a heart contracts and dilates under such circumstances, air must enter the ventricles during their diastole, and be expelled during their systole, and the friction of the air against the parietes of the orifices of the heart is quite as capable of developing sound as the friction of a fluid.

Three theories of the manner in which sound is produced by the contraction of the muscular fibres of the ventricles of the heart have been proposed. Dr. Hope, as I have already observed, refers it to "muscular extension;" Dr. Blakiston,* to friction between the muscular fibres themselves during the act of contraction; and others, to "bruit musculaire."

According to Dr. Hope, the sound of muscular extension is "a loud, smart sound, produced by the abstract act of sudden jerking extension of the already braced muscular walls at the moment when the auricular valves close." With respect to this theory of the production of sound, I must confess I do not exactly understand how sound can be produced in this way at all resembling the first sound of the heart.

By many physiologists the first sound of the heart has been referred to "bruit musculaire," which, according to Mr. Bowman,† is "an exceedingly faint silvery vibration." The mechanism by which bruit musculaire is produced may (he thinks) be explained "by supposing the several fasciculi to be in rapid and constant motion, one against the other, by varying amounts of contraction in different fasciculi and parts of fasciculi." Dr. Blakiston's theory of friction between the muscular fibres, themselves, and Mr. Bowman's theory of the mechanism of bruit musculaire, seem, therefore, to be pretty nearly the same.

Laennec‡ was the first to call attention to bruit musculaire in connection with the sounds of the heart. In the part of his work where he endeavours to explain the mechanism by which bruit de soufflet is produced, he observes:—"When the naked ear or the stethoscope is applied over a muscle in a state of contraction, or, better still, upon one extremity of the bone to which the muscle is attached, we hear a sound analogous to that of the wheels of a carriage at a distance, and which, though continuous, is evidently formed by a succession of very short and quickly succeeding sounds; or if, with the head resting upon a pretty firm pillow, the masseter muscles are strongly contracted, and then contracted with less force; in the former instance the wheel seems to roll with great rapidity upon a hard surface, in the latter it seems to roll over a rough pavement."

Dr. Williams,§ who refers the prolongation of the first sound of the heart to bruit musculaire, observes:—"Whenever there is strong abrupt muscular action in any part of the body, like that of the heart, there will be heard a sound which will resemble that of the ventricular systole in proportion as the muscles in which it is produced resemble in thickness and density the tissue of the heart; as when we apply the stethoscope to the adductor muscle of the thumb of the closed hand, and contract the muscle strongly and quickly; or, to avoid the possibility of the joints being the seat of the sound, if we apply the end of a flexible tube to the abdominal muscles, and start them into sudden vigorous action, we may thus get sounds quite as loud as those of the ventricles, and very like them in character. By varying the mode of this muscular action different kinds of sound may be produced. When the contraction is slow or sustained, however strong, we have only the dull rumbling noise which Dr. Wollaston described, and which he attributed to a vibration depending on a regular intermittence in the force of the contraction. When the contraction is gentle and slow, it may cause no sound at all; as we have seen that the auricles produce no sound, neither do the ventricles when their contraction is very feeble."

Dr. Watson,* who likewise adopts the theory of bruit musculaire, observes, in reference to the first sound of the heart:—"If, during the stillness of the night, when lying in bed, you set the teeth firmly, you will hear a continuous dull rumbling, caused evidently by the action of the masseter and the temporal muscles."

Now, the dull rumbling sound which is heard under such circumstances, if it is to be taken as the type of bruit musculaire, is very unlike the first sound of the healthy heart. It is a continuous, dull, rumbling noise, and has a much greater resemblance to the venous murmur heard in the jugular veins in cases of anæmia than to it. Indeed, I am convinced that this sound has not its seat in the masseter or temporal muscles, for it is heard only in the ear which rests against the pillow, not in the opposite ear. The ear must likewise be pressed pretty firmly against the pillow, by which the air is confined between the tympanum and the external ear. Indeed, a sound altogether similar will be heard if the ear is stopped with the finger, and the temporal and masseter muscles are then strongly contracted. The sound has certainly nothing of the "faint silvery vibration" which, according to Mr. Bowman, characterises bruit musculaire; and the theory which refers the prolonged portion of the first sound of the heart to it, appears to me to rest upon too hypothetical grounds to entitle it to be considered as the cause of this sound, or of any portion of it.

Objections to the theory of the recoil of the blood upon the arterial valves as a cause of second sound.—The second sound of the heart is generally supposed to have its cause in the sudden extension or closure of the sigmoid and semilunar valves, owing to the recoil of the column of blood in the arteries above upon those valves, when the ventricular systole cases; or to the shock of the column of blood upon these valves at the period of the ventricular diastole; or to both combined.

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* Practical Observations on Diseases of the Chest.

† Philosophical Transactions.

‡ Traité de l'Auscultation Méd. tome II.

§ On Diseases of the Chest.

* Lectures on the Practice of Medicine.

That these valves close their respective orifices at the period in question, there is no doubt; but, that the act of closure of these valves, or that the recoil of the column of blood upon them, occurs with sufficient force to develope the second sound of the heart, I have considerable doubt; and for several reasons.

In the first place, the sigmoid and similunar valves close their respective orifices the very moment that the onward current from the ventricles ceases; consequently at the instant that the ventricular systole ends.

2. The closure of these valves is described by some as a sudden flapping action, which is considered to be sufficient to develope this sound. But these valves do not flap against one another, and it connot be against the blood which then begins to enter the ventricles by the auriculo-ventricular orifices, because the arangement of the tricuspid and mitral valves is such, that the blood does not reach them at this period.

3. The majority of physiologists attribute the second sound of the heart to the recoil of the column of blood in the arteries above upon the closed valves. But the amount of force with which a column of blood should fall upon them, in order to develope the second sound of the heart, would necessarily soon cause these valves to be reversed; and, if they were exposed to such a rude shock at every diastole of the ventricles, few persons could attain adult age, in whom they would not permit regurgitation.

Those who adopt the foregoing theory of the mode of production of the second sound of the heart, seem to argue as if the arteries were inelastic tubes, and that the blood in the aorta and pulmonary artery had a backward as well as a forward motion. If this were so, it could hardly fail to be perceived in the large arteries which come off from the arch of the aorta: while for a column of blood to come in contact with these valves with sufficient force to develope the second sound of the heart, presupposes an empty space in the artery above them, into which the blood falls back each ventricular diastole. But as long as the artery preserves its elasticity, nothing of the kind can occur; the blood does not recoil with any force, or from any distance, upon these valves, because the artery immediately above them is filled equally with the other parts of the tube. In fact, the instant that the onward current from the ventricles ceases, the blood by its simple weight depresses these valves, and as long as the parts are healthy there is no recoil of a column of blood upon them. But when, as occasionally happens, the arch of the aorta loses its elasticity, and becomes dilated, there is then certainly a recoil of the blood contained in it upon the semilunar valves; and this state almost always eventually ends in patency of the aortic valves.

Pathological evidence in favour of the theory of friction between the blood and the parietes of the orifices as a cause of the sounds.—It will now be necessary to adduce some pathological evidence that the sounds of the heart are caused by friction between the blood, and the parietes of the orifices of the ventricles, during their systole and diastole. I have already said, that a double sound, which cannot be distinguished from the normal double sound of the heart, is heard in cases of aneurism of the arch of the aorta; and that in certain instances the first of these sounds, in others the second, and in others again both these sounds, are converted into murmurs, altogether analogous to the murmurs which accompany diseased states of the orifices and valves of the heart. That the aneurismal sounds are caused by friction between the blood, and the parietes of the orifice of the sac, requires no proof, because there is no other agency to which they could be referred. This is at least evidence that a valvular apparatus and muscular walls are not essential to the production of sounds analogous to those of the heart. The conditions common to both are a cavity into and out of which the blood passes with more or less force and rapidity; and if the friction between the blood and the parietes of the mouth of the sac of an aneurism is capable of developing, not merely a double sound, similar to that of the heart, but murmurs which differ in nothing from those developed in diseased states of the heart, the same agent is evidently equal to produce analogous sounds at the orifices of the ventricles.

First sound.—If the first sound of the heart has its cause in the friction between the blood and the parietes of the arterial orifices; and if murmurs are nothing more, in the great majority of cases, than exaggerated normal sounds, then the normal first sound of the heart ought to be converted into a murmur, whenever an impediment is offered to its exit; when the blood is propelled with increased force and velocity, or when the qualities of the blood are altered, and this fluid loses its viscidity and becomes more watery than natural; because in these several cases the friction between the blood and the parietes of the orifice is increased. The sound ought to diminish in intensity, or in duration, when less blood is transmitted by the ventricle, or when it is transmitted with less force; and it ought to be more prolonged than natural when an increased quantity of blood is transmitted by the ventricle during its systole: and this is exactly what does occur. For instance—

1. Whenever the aortic orifice or its semilunar valves become diseased so as to *obstruct* the outward current of blood, the normal first sound of the heart is converted into a murmur, which will have either a blowing, rough, or harsh character, according to the amount of the obstruction, and to the force and velocity of the current.

2. When the walls of the left ventricle are hypertrophied, and the blood is propelled through the aortic orifice with increased *force*, although there is no impediment to its exit, the normal first sound may be converted into a murmur. In the

ordinary explanation of the mechanism by which the first sound is produced, a murmur from this cause ought not to occur.

3. When the viscidity of the blood is diminished, and this fluid is propelled with increased *velocity* through the aortic orifice, the normal first sound is converted into a murmur.

4. When the walls of the left ventricle are thinned, and its cavity is dilated, the first sound of the heart comes to resemble the second sound, because the blood is propelled with less force, less blood is transmitted through the arterial orifice, and the systole lasts a shorter time.

5. When the walls of the left ventricle are softened, or have undergone the fatty degeneration, the first sound of the heart becomes more feeble, because the blood is propelled into the aorta with much less force ; and, when the aortic orifice or the semilunar valves are diseased so as to obstruct the outward current from the ventricle, no abnormal sound will be heard, because the force of the current in such cases is too feeble to convert the first sound of the heart into a murmur.

6. When the cavity of the left ventricle is dilated, and its walls are increased in thickness, a larger amount of blood will be transmitted at each ventricular systole, and the first sound of the organ will necessarily be prolonged.

7. When the cavity of the left ventricle is not filled at the period of its systole, the first sound of the heart will be diminished in proportion, and will consequently be shorter than natural. M. Piorry attributes clearness of tone to the amount of blood contained in the ventricle, rather than to thinness of the parietes: "the sound is clearest (he observes) when the heart is most empty, yet is contracting with energy, as in palpitation."

It may be objected to the foregoing theory that the abnormal sound does not always replace the normal first sound of the heart, and that the latter is still heard in some cases of valvular disease along with it. But as valvular disease is almost limited to the left side of the heart, the abnormal sounds are limited in the same proportion to the left side ; and, if the normal sound is audible along with the abnormal, it is, of course, the normal sound of the right side of the organ which is then heard, and which the murmur was not sufficiently intense to mask completely.

Second sound.—If the second sound of the heart has its cause in the friction between the blood and the auriculo-ventricular orifices, it ought to diminish in intensity whenever there is any impediment to the entrance of the blood from the auricle, or when the ventricle remains distended, owing to its inability to empty itself. This sound is very seldom converted into a murmur, because there is nothing to increase the force with which the blood enters the ventricles from the auricles, though there are several which may diminish the force or velocity of the current from the auricles into the ventricles. For instance—

1. When the mitral orifice is much contracted, the second sound of the heart will diminish in intensity ; and, when the contraction is extreme, it is scarcely audible, because but little blood can enter the ventricle from the auricle during the ventricular diastole.

2. When the ventricles of the hearts of animals submitted to experiments were gorged with blood, the second sound was scarcely heard, or ceased, because a sufficiently strong current of blood could not enter the ventricle to develope sound. This was noticed both in the experiments performed in the United States and in England. "The second sound (Drs. Pennock and Moore observe) by the congestion of the ventricles ceasing first on the right side." "When the heart was gorged, towards the conclusion of the experiments, the first sound (Dr. Hope observes) only was heard."

3. Although the second sound itself is seldom converted into a murmur, a murmur which masks the second sound is by no means rare, and is heard whenever the aortic valves permit regurgitation. Why a murmur should be heard in this case, or why the second sound of the heart should be seldom converted into a murmur, is easily understood. When the mitral orifice is contracted, less blood can enter the ventricle during its diastole, and the second sound becomes more feeble than natural : it is not converted into murmur, because the force with which the blood enters the ventricle from the auricle is too slight to produce this effect. On the other hand, when the aortic valves permit regurgitation, as these valves are on a higher plane than the auriculo-ventricular orifice, and as it is the blood contained in the aorta above these valves which regurgitates into the ventricle, the amount of friction between the blood and the abnormal orifice is sufficient to generate a murmur in this case, though not in the former : but, the force with which the blood regurgitates into the ventricle never being so great as that with which it is expelled from the ventricle, the murmur of aortic regurgitation is always soft and blowing, and never acquires the rough harsh character which a systolic murmur often presents.

In addition, we know, that when patency of the aortic valves exists, two currents of blood must enter the ventricle at every diastole ; that through the aortic orifice being the strongest, for the reasons already given : a smaller amount of blood will therefore necessarily enter by the auriculo-ventricular orifice, and the force with which it enters will be diminished, because the ventricular cavity is partially filled by the backward current through the aortic orifice. Hence we have another reason why the normal second sound should become more feeble than natural, and why it should be so readily masked by the louder sound of aortic regurgitation.

Lastly, the occurrence of intermission of the heart's sounds, or irregularity of the heart's action, which are with difficulty explained on the theory of the heart's sounds ordinarily received, admit of a ready explanation on this. For instance—

If too little blood is expelled by the left ventricle at each systole to communicate a pulse to the radial artery, and if this occurs at every second, third, or fourth beat, as the case may be, there will necessarily be an intermission of the pulse; while, if the amount of blood is too small, or the force with which it is propelled too slight to occasion friction at these periods between the blood and the parietes of the orifice, the heart's sounds themselves will be intermittent.

If the left ventricle becomes overloaded or overdistended with blood, or its parietes are weak, the systole of the ventricle may be repeated several times for one diastole; and this may occur at short intervals, so that the pulse may be felt to give several rapid and small beats, and then several stronger and more regular beats, as if it were the pulse of two different persons; and the same irregularity will be perceived in the sounds of the heart when the stethoscope is laid on the præcordial region.

These phenomena, which scarcely admit of explanation according to the ordinary theory of the heart's sounds, admit of a ready explanation if we admit that the sounds are due to the friction between the blood and the parietes of the orifices of the ventricles; that if little blood is transmitted, or it is transmitted with little force, little sound can be produced; while, when the force and velocity of the circulation are increased, the friction will be increased in proportion; and, when an impediment is offered to the passage of the blood under such circumstances, the normal sound will be converted into a murmur.

Examination of the heart in disease—Signs furnished by inspection of the chest, and the application of the hand—Impulse of the heart—Diminution of the impulse—Increase of the impulse—Alterations in the situation of the impulse—Sound produced by the impulse of the heart—Turgescence and pulsation, and of the jugular veins.

EXAMINATION OF THE HEART IN DISEASE.

The anatomy and physiology of the healthy heart having been dwelt upon at sufficient length, we have next to consider the heart in disease, and to describe the several methods of proceeding, in order to determine the nature, the situation, and the extent of the morbid changes. And here we shall find the advantage of the preceding details, inasmuch as we shall be in a position to recognise readily any alteration in the heart's impulse, either as respects its strength, or the situation in which it is felt: we shall be able to detect any difference in the extent and degree of the heart's superficial dulness, or any change in the character of its sounds.

In cases where the heart is diseased, or suspected to be so, several distinct methods of examination require to be employed; the eye, the touch, the ear, are each capable of affording us assistance in arriving at a diagnosis, and the indications afforded by each mutually assist the others. These methods of examination may for convenience sake be considered under the heads—inspection of the chest; palpation, or the application of the hand to the parietes; percussion; and auscultation—upon each of which it will now be necessary to delay for a short time.

Signs furnished by inspection of the chest, and the application of the hand.—Inspection of the chest,—in other words, the examination of the external surface of the thorax, and the application of the hand to the præcordial region,—should never be omitted; they are capable, alone, of affording positive information in several diseased conditions; they aid and assist our other means of arriving at a diagnosis; and, as preliminary steps to other and more difficult methods of exploration, they can scarcely be dispened with, if we wish to make an accurate examination.

As these two methods of physical examination mutually assist one another, they may be considered together. Thus, by inspection of the chest we determine the exact point at which the apex of the heart comes in contact with the parietes of the chest, and by the application of the hand we determine the amount and the strength of its impulse. By inspection of the chest we ascertain whether the two sides of the thorax are symmetrical, and we detect any protrusion in the præcordial region; by it we recognise unusual pulsation at any part of its parietes, in the large arteries which come off from the arch of the aorta, as well as in the jugular veins, or in the epigastric region; by the application of the hand we determine the strength and force of the pulsation; we judge of the frequency or slowness of the heart's action, and of the regularity and irregularity of its movements. By the application of the hand, likewise, we recognise the peculiar phenomenon known under the name of fremissement cataire, or purring tremor; and by the same means we can detect friction between the opposed and roughened surfaces of the pericardium in inflamed states of the membrane.

Impulse of the heart.—The application of the hand to the præcordial region is necessary in order to judge of the strength or feebleness of the heart's impulse: with this view, the hand may either be placed directly upon the surface of the chest, or, holding the ear end of the stethoscope, we apply its opposite extremity to the part, when the extent to which the instrument is elevated, and the force with which this is accomplished, will give us a pretty accurate idea of the strength of the heart's impulse. This kind of mediate palpation is principally useful in hypertrophy, or hypertrophy with dilatation, of the ventricles.

The impulse of the heart varies, even in healthy individuals, according to the development of the chest, according to the size of the lungs, according to the fatness or leanness of the individual, according to the stature of the subject, and to the size of the abdomen. In the healthy subject, with a well-formed chest, the impulse of the heart is so slight as not to be perceptible to the individual himself, and is felt only at one point—viz. between the cartilages of the fifth and sixth ribs on the left side; that is, from one to two inches below the nipple, and to the sternal side of this point When the parietes of the chest are much loaded with fat, the impulse is often scarcely perceptible to the hand; while in thin persons it is evident also to the eye. In such cases, when the heart's action is vigorous, it will be perceived to be double; and this in certain states of disease becomes very perceptible.

In examining the heart, it is necessary to bear in mind that the impulse is somewhat stronger in the erect than in the recumbent posture; that in a forced inspiration the impulse is diminished, and felt slightly lower down than natural; a deep inspiration elevating the ribs without raising the heart in the same degree, while it depresses the diaphragm. That in a forced expiration the impulse becomes more perceptible, and is felt slightly higher up; a forced expiration depressing the ribs and elevating the diaphragm. It may therefore be necessary to make the patient vary his position, and to examine the heart both during inspiration and expiration. In some individuals the impulse is naturally weak; in others naturally strong: the same may be said of the pulse and of the sounds of the heart, although the parts are in a perfectly normal condition in each. As the impulse is increased by exercise, or exertion, or by mental excitement, we should be careful to examine the heart, suspected to be diseased, when the patient is perfectly calm and tranquil.

In some morbid conditions of the heart or lungs the impulse is either very slight, or altogether absent. In others it is so strong as to be disagreeable to the individual, and to be visible without removing the patient's clothes, and the extent of surface over which it is felt is much increased. In others the impulse becomes perceptibly and strongly double; and in others again the seat of the impulse is altered.

Diminution of the impulse.—Diminution of the impulse of the heart may depend either upon feebleness of the action of the heart, which may have its cause in disease or alteration of its muscular tissue, or in general debility of the system; or it may depend upon the apex of the organ being prevented from coming in contact with the parietes of the chest with sufficient force to communicate an impulse, owing to disease in the lungs or pericardium.

The impulse of the heart is circumscribed or feeble in softening of the heart, and in atrophy of its muscular substance with fatty degeneration of its tissue. In states of considerable general debility it is feeble. The impulse is diminished likewise in attenuation of the walls of the ventricles, with dilatation of their cavity. If the anterior margin of both lungs is emphysematous, and they overlap the heart, the apex may be prevented from coming in contact with the parietes, and the impulse will be much diminished. In cases of considerable effusion into the sac of the pericardium, the impulse is absent altogether, or it is unequal and undulating, as if propagated through a fluid. In cases even of hypertrophy with dilatation of the ventricles, the impulse may be diminished, "it becomes a mere oppressed struggle," if the heart is overloaded with blood and the lungs are much congested.

Increase of the impulse.—Increase of the impulse of the heart, as a general rule, occurs under the very opposite conditions of the organ to those under which diminution of its impulse is observed, and in almost every instance has its cause in some morbid state of the heart itself. The impulse is stronger than natural in hypertrophy of the walls of the left ventricle, and it arrives at its utmost limit in hypertrophy with dilatation of the ventricles: in such cases the impulse is slow, gradual, heaving, double, and occasionally so violent as to shake the bed on which the patient lies. The character of the impulse of the heart thus becomes a most valuable sign of hypertrophy with dilatation: "the slow, progressive, heaving impulse could be produced by no other cause." In such cases, likewise, the extent of surface over which the impulse of the heart is felt is much increased, and the whole side of the chest is sometimes elevated by the movements of the organ. It is in this form of disease that the double impulse is so well marked, the diastole as well as the systole of the ventricles being accompanied by an impulse: this is sometimes termed the back stroke of the heart,—more correctly the diastolic impulse. The ventricles may, however, be hypertrophied, M. Piorry observes, without the impulse being much increased. He says, that in aged females at the Salpetrière very little impulse is often felt, although the heart is frequently much thickened; while in nervous subjects with small hearts the impulse is frequently very strong. He is of opinion that increased impulse is to be considered "an indication rather of the force of the blow than of the thickness of the parietes of the ventricles."

In hypertrophy with a predominance of dilatation, the impulse, as Laennec observes, is abrupt, short, and knocking, and in the fits of palpitation the shock resembles the blow of a hammer. "The blow seems (as Dr. Hope remarks) to strike a small space: it expends itself, as it were, on the thoracic parietes, and does not communicate a heaving proportionate to its force." "It differs from the impulse of great hypertrophy, in the circumstance that in the latter the ventricles in a distended state seem to heave with their whole length against the thoracic parietes, which yield to the effort, while in the former the point only of the heart seems to strike the parietes with a sharp, smart, accurately circumscribed blow, only capable of producing a sort of concussion rather than a real heaving."

The impulse of the heart is stronger than natural in the early stage of endocarditis and of pericarditis; likewise in attacks of palpitation from any cause; and it is apparently stronger when a morbid growth behind the heart protrudes the organ forwards, as in certain rare cases of aneurism in the descending portion of the thoracic aorta. The impulse becomes sharper and more knocking in nervous and hysterical subjects, particularly during fits of palpitation; in such cases it is often very troublesome to the patient, and is occasionally accompanied by perceptible sound, while its double character can, not unfrequently, be recognised.

Alteration in the situation of the impulse.—The situation at which the impulse of the heart is felt is not unfrequently altered by disease, either of the heart itself, of the lungs, or pleura, by the development of morbid growths in the cavity of the thorax, or by morbid or other changes in the contents of the cavity of the abdomen; and these alterations in the side of the impulse may be the result either of the increased volume which the heart itself attains, or of displacement of the entire organ. Thus—

In hypertrophy of the left ventricle with dilatation of its cavity, the heart being increased in length, its impulse will be felt lower down than natural, and more to the left side, and not unfrequently on a line with the axilla. In hypertrophy with dilatation of the right ventricle, the impulse will, for the same reason, be felt lower down and more to the right side than natural, and not unfrequently on a line with the xyphoid cartilage. In the former case the impulse is progressive, heaving, and strong, elevating the head of the observer, and is felt over a much larger surface than natural; in the latter the impulse is neither heaving, prolonged, or very strong, and is felt usually over a circumscribed space.

The entire organ is displaced laterally in cases of empyema, or where liquid to a considerable extent has been effused in the pleural cavity on either side; towards the left side when the right pleural cavity is its seat, and towards the right side when the left pleural cavity is its seat: in the latter case the impulse is frequently felt upon the right side of the sternum. The heart is pushed upwards, and the impulse is felt on a plane higher than natural, in ascites, in cases of large ovarian or other abdominal tumors, in hysterical tympanitis, and the advanced stages of pregnancy. The heart is displaced slightly downwards in cases of emphysema of both lungs of long standing, and the impulse is felt on a plane lower than natural, not unfrequently in the epigastric region. In cases of effusion of fluid into the pericardial sac, the impulse is felt sometimes at one, sometimes at another part of the præcordial region. In individuals with narrow, deformed, or contracted chests, the impulse will be felt beyond its normal limits. In individuals, on the other hand, with broad and expanded chests, the site of the heart's impulse is usually circumscribed.

Sound produced by the impulse of the heart.—Although under ordinary circumstances sound is not produced by the impulse of the heart, and no shock or blow is given to the parietes of the chest by the apex of the organ during the ventricular systole—the intercostal space between the cartilages of the fifth and sixth left ribs being merely elevated by the apex of the heart in the gliding movement performed by it at this period of the heart's action—yet, under certain circumstances, sound is really produced by this act, which in certain rare cases is sufficiently loud to be heard without the stethoscope, and at a short distance from the patient, and is audible to the patient himself.

Corvisart only once witnessed this phenomenon. Laennec states that in at least twenty instances which he met, this sound was sufficiently loud to be audible at a distance of from two inches to two feet from the patient's chest. "In only three or four of these cases at the utmost, organic disease of the heart existed; in all the others the palpitation was purely nervous. Bruit de soufflet and fremissement often existed in a slight degree in the heart, but particularly in the arteries of those who presented this phenomenon."

In order that sound should be produced by the impulse of the heart, the organ must act strongly, the subject must be thin, the heart must be a good deal uncovered by lung, and the apex of the organ must come in contact with the rib or its cartilage with sufficient force to produce sound.

According to Dr. Hamernck, "all true heart-sounds are heard by mediate or immediate auscultation only." "This sound, however, is heard at a distance from the chest, and is considered by him to depend upon the motion imparted to the surrounding elastic tissues by the heart's systole." According to Dr. Hope, the manner in which the sound is produced is as follows: "The heart in gliding forwards and upwards during its systole strikes with its apex against the *inferior margin* of the fifth rib, and thus creates an accidental sound, attended with *cliquetis* when the blow is smart. It may be prevented at pleasure, by pressing the edge of the stethoscope, or any thing else, into the intercostal space, by which that space is put internally on the same plane as the rib, over which the heart then glides without catching." He adds, that "he has never found the sound to occur in any but the meagre, because in the well-conditioned the intercostal spaces are full and resistant; and consequently the edge of the rib is not exposed."

"I infer," Dr. Hope observes, "that the *tinnitus* itself proceeds simply from reverberation of sound within the cone of the stethoscope." Dr. Williams, in reference to the same point, remarks—"The metallic clink originates in the ear of the observer, and has nothing to do with the heart, further than that it is excited by the blow which the heart communicates to the ear. We may hear the very same note by laying the ear flat upon a table, and tapping the under side of the table just opposite to it. I believe this to be the proper note of the tympanum. We often hear it on auscultation, and when once aware of it, it is easily recognised as belonging to the observer, and not to the patient. It is easily produced when the heart strikes against the ribs, and the external knocking sound is added to the intrinsic systolic sound." In order to hear the metallic clink, M. Bouillaud says "it is better not to employ a stethoscope, but to apply the ear immediately upon the patient's chest." "This sound (he observes) being sometimes heard with the naked ear when it would be inaudible with the stethoscope."

Turgescence and pulsation of the jugular veins.—Among the signs which are evident on inspection of the chest, and which accompany the advanced stage of some forms of cardiac disease, a state of permanent turgescence or distension of the jugular veins, with or without pulsation, is by no means unfrequent. The former is the most common, and may occur in any case in which an impediment exists to the free passage of the blood through the right side of the heart. The latter is observed in cases in which, in addition, the tricuspid valve imperfectly closes the right auriculo-ventricular orifice, and free regurgitation into the auricle is permitted at each systole of the right ventricle.

Turgescence and pulsation of the jugular veins were first noticed by Lancisi as signs of cardiac disease. He referred them to dilatation with hypertrophy of the ventricles, or, as it was then termed, "aneurism of the heart." Corvisart had little confidence in them as signs of disease of the right side of the heart. Laennec, however, regarded the turgescence without pulsation of these veins as a frequent attendant upon dilatation of the right cavities of the heart, and he says that "pulsation in the same veins was present in every case which he had met with of considerable hypertrophy of the right ventricle."

The internal and external jugular veins receive the blood from the interior and exterior of the head, from the face and neck. Now if there is any impediment to the free passage of this fluid through the right side of the heart, whether depending upon disease in the right or left side of the organ, or of the lungs, these veins become distended and turgid. If, in addition, the tricuspid valve does not perfectly close the right auriculo-ventricular orifice, a portion of the blood, at each systole of the right ventricle, instead of passing into the pulmonary artery, will be transmitted backwards into the right auricle, and will re-act upon its contents, and through it upon the blood descending by the superior cava and its branches, when a pulsation will be communicated to the jugular veins at each systole of the right ventricle, which will persist although pressure be made upon the vein above it.

Turgescence of the jugular veins.—The diseased condition of the heart in which turgescence of the jugular veins is most frequently observed is dilatation of the right auricle and ventricle, with or without hypertrophy of the same parts. It is, however, by no means to be considered as a symptom belonging exclusively to this form of disease, for it is often the result of obstruction, or regurgitant disease at the left side of the heart. It may accompany any impediment to the free circulation of the blood through the cavities of either side of the heart. It is observed sometimes in aneurism of the arch of the aorta, as well as in diseased conditions of the lungs, accompanied by obstruction to the pulmonary circulation. The turgescence is usually limited at first to the external jugular veins, particularly on the right side: it is not constant, and can always be removed by compressing the vein above. Eventually both the internal and external jugular veins become distended and turgid, sometimes to an extreme degree. This state is permanent, though it can still be removed by pressure upon the vein higher up. In some few cases, the veins, in addition to being dilated, become tortuous, and present the appearance with which we are familiar in the varicose state of the veins of the lower extremity.

Pulsation of the jugular veins.—The veins in which pulsation is observed are the internal jugulars, those vessels not being provided with valves like the external. The pulsation is always most evident immediately above the clavicles, and it may extend half-way up the neck when the latter is short; but I have never found it to reach higher. It is usually best marked on the right side, and is frequently perceived upon both sides, and sometimes, though rarely, only on the left side. The pulsation is too feeble in the great majority of cases to be felt by the finger, but, in several instances which have come under my own observation, a pulsation was communicated to the finger placed lightly upon it. This could not be confounded with the pulsation of the artery underneath, which is likewise generally increased at the same time; as, it was very feeble, was perceptible only on slight pressure, and disappeared when this was increased, when the impulse of the artery alone was felt.

The movement in jugular pulsation is rapid, vermicular and double, the backward current of blood forming the first and strongest movement, and the direct current its second and slighter movement. According to Dr. Sibson, there is in the healthy state "a constant visible pulsation, both in the deep and superficial jugular veins, which pulsation, though perfectly visible, cannot be felt." It is much diminished, and in many persons rendered invisible, during a deep inspiration. "The mere existence of jugular pulsation (Dr. Sibson observes) is anything but an indication of disease, either in the pulmonary valves, or elsewhere." "In those diseases (he adds) where the flow of blood through the lungs and heart is impeded, the jugular veins contain more blood, and their pulsations are more visible than in health; but where the impediment is extreme, the veins are in a state of constant distension, and no pulsation is visible."

Pulsation of the jugular veins is present in every case in which the tricuspid valve imperfectly closes the right auriculo ventricular orifice, and in which free regurgitation occurs at each ventricular systole, provided the walls of the right ventricle are sufficiently strong to communicate a backward impulse to the current of blood which descends by the jugular veins. Hence it is almost always observed in hypertrophy with dilatation of the right cavities of the heart. Pressure upon the vessel between the site of the pulsation and the heart is always sufficient to stop it.

Fremissement cataire, or purring tremor—Circumstances under which fremissement cataire is felt—Cause of fremissement cataire—Signs furnished by percussion—Alterations in the extent and degree of the heart's superficial dulness—Conclusions respecting percussion of the præcordial region.

THE cause of jugular pulsation was first satisfactorily explained by MM. Bertin and Bouillaud—viz., that it depends upon regurgitation into the great veins during the contraction of the right ventricle; and this theory of its cause has been almost universally adopted. Dr. Hope, however, supposed that it might have its cause in the recoil of the tricuspid valve upon the blood, when the hypertrophied ventricle contracted with increased force, and that the column of blood descending into the ventricle would be repelled with sufficient force to propagate its impulse as far back as the jugular veins. From the explanation which has been given of the manner in which the curtains of the auriculo-ventricular valves close their respective orifices, it would appear that jugular pulsation could scarcely be produced in that way. Why regurgitation is permitted at the tricuspid orifice so frequently, as well as the exact manner in which it occurs, have been already alluded to in treating of the "safety-valve function of the tricuspid valve."

FREMISSEMENT CATAIRE, OR PURRING TREMOR.

Another sign which is recognised only by the application of the hand to the parietes of the chest is the "fremissement cataire" of Laennec, the "purring tremor" of English writers, the "frottement fremissement ou vibratile" of Gendrin; named so by Laennec, from its resemblance to the peculiar sensation experienced if the hand is laid upon the back of a cat when the animal is making the peculiar purring sound which it does when pleased; and compared by M. Bouillaud to the thrill felt on placing the hand upon the larynx of a person singing. It is a peculiar thrill, or vibratory sensation, very easily recognised, sometimes perceptible on very slight pressure upon the part, sometimes requiring a stronger pressure in order to be felt, and communicated equally by the large arteries as by the heart.

This phenomenon had been recognised as a sign of cardiac disease previous to the discovery of auscultation. Corvisart, speaking of the symptoms of disease of the left auriculo-ventricular orifice, observes—"Among the symptoms of this affection there is a peculiar confused sensation, difficult to describe, felt by the hand applied to the præcordial region." He supposed it to indicate a contracted state of the mitral orifice, causing an impediment to the passage of the blood from the left auricle into the left ventricle. Burns evidently alludes to this phenomenon when he speaks of a "jarring motion accampanying the pulsation of the heart;" and, as he noticed it in several cases where, on a post-mortem examination, the opposed surfaces of the pericardium were found to be adherent, he attributed it to this lesion, causing an impediment to the free action of the heart.

Fremissement cataire is not limited to the heart, but is perceptible also in the large arteries, and in aneurism, particularly in varicose aneurism, in which it is often better marked than in the heart. It is felt over the large arteries when the lining membrane of these vessels is extensively diseased, as well as in cases where no morbid alteration of the parts exists; and its cause, or the mechanism by which it is produced, do not seem to have ever been fully explained. Laennec* observes—"It would seem that the immediate cause of a phenomenon so marked as frémissement cataire would be easily discovered. I confess, however, that, notwithstanding the pains which I have taken in this respect, I have not been able to find any satisfactory reason." "It appears to me (he adds) extremely probable that it is owing to some peculiar modification of innervation." M. Bouillaud,† in the second edition of his work on the heart, expresses himself in somewhat similar terms:—"What are the other causes capable of producing this phenomenon (he observes) I am ignorant. It appears to me that there is a certain condition of the blood, as well as of the parietes of the heart and arteries, which favours its production. But in spite of the assiduous researches to which I have devoted myself on the subject, I have not yet been able to determine properly all these conditions."

Circumstances under which fremissement cataire is felt.—In every instance in which fremissement cataire is felt, a murmur of some kind is audible on auscultation, which is frequently blowing, and sometimes rough or harsh. It is obvious, therefore, that the cause which produces the latter is connected with the cause which gives rise to the former; but, as fremissement cataire is not felt in *every* case in which an abnormal sound is heard, it is obvious that there must be something superadded when the latter is felt to allow of this peculiar sensation being communicated to the hand.

The morbid condition of the heart in which this phenomenon is most generally perceptible is where the left auriculo-ventricular valve permits regurgitation, and the ventricle is at the same time hypertrophied. The morbid conditions in which it is felt in the arteries are where the aortic valves permit free regurgitation, or where the arch of the aorta is dilated, its lining membrane rough and irregular from adventitious deposit, and the large vessels which come off from its arch are likewise dilated; where an aneurismal sac springs from a large artery, where a free communication exists between a vein and artery, as in varicose aneurism; or, finally, where the blood is altered, its viscidity diminished, its watery parts increased, and the vessels are in an unfilled state.

Two or more of the foregoing states may be combined together, by which the thrill will be increased. Thus dilatation of the arch of the aorta may be combined with disease of its lining membrane, and both may be combined with a state of the aortic valves permitting regurgitation; or dilatation of the large arteries, or regurgitant disease of the valves of the heart, may be combined with a state of anæmia and alteration of the blood.

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* Auscultation Mediate, tom. ii.

† Traité des Maladies du Cœur, tom. i.

Cause of fremissement cataire.—In every case in which fremissement cataire is felt, whether in the heart, or in the arteries, or in aneurism, the cavity or the vessel is in an *unfilled* state. Thus in the heart it becomes perceptible when the mitral valve permits regurgitation; in the large arteries, when the aortic valves are patent, when the arteries themselves are dilated, when an aneurism exists, or when a communication exists between a vein and artery. In several of the foregoing cases, regurgitation of the blood occurs; this presupposes an unfilled state of the vessel or cavity: it could not occur if they were distended. Now I consider this unfilled state of the vessels combined with a certain amount of force and velocity of the current of blood to be the immediate cause of this phenomenon: the thrill or vibration communicated to the hand being more marked when the lining membrane of the part is rough or irregular from disease.

For instance, we can produce a fremissement at any time in a large artery in a healthy subject by making pressure upon it; the thrill is not felt at the point upon which the pressure is made, nor between it and the heart, but at the distal side of the point of pressure, and where the vessel must necessarily be in an unfilled state; a murmur is heard at the point compressed, and both cease as soon as the pressure is removed. We know, too, that a thrill, identical with fremissement cataire, is felt in cases where the heart and arteries are perfectly healthy, but where the vessels are in an unfilled state, as in anæmia, depending upon hæmorrhage or other causes.

A certain amount of force and velocity of the current of blood appears to be likewise necessary to its full development; because we find that this phenomenon sometimes diminishes or even disappears in diseased states of the heart, when the action of the organ becomes tranquil, and that it reappears again when the heart's action is excited by exercise. It disappears likewise when the action of the heart becomes feeble, and ceases altogether in the last stage of valvular disease when the circulation through the heart is much impeded

The jarring pulse in the radial artery, with which we are familiar in cases of patency of the aortic valves, appears to be nothing more than the fremissement cataire felt in an artery of small calibre. The thrill communicated to the finger is characteristic of an unfilled state of the arteries, and becomes perceptible whenever the semilunar valves of the aorta imperfectly close the orifice, or when regurgitation occurs into the aorta from the large arteries which come off from its arch. The same character of the pulse is observed in cases where profuse hæmorrhage has occurred; and in a less marked degree in cases of anæmia from other causes.

Fremissement cataire may or may not be a sign of organic disease; in the majority of cases it is: thus, whenever it is felt in the præcordial region, accompanies the ventricular systole, and is well marked, it indicates valvular disease; and the form of valvular disease which will be found under such circumstances is a state of the mitral valve or orifice permitting regurgitation. In the large arteries, on the other hand, a fremissement may be felt, although no organic disease of the vessel exists. In some instances this phenomenon is perceptible when the hand is laid gently upon the parietes: in others stronger pressure is required in order to develop it. Thus in varicose aneurism, the result of a wound of an artery and vein, a thrill is communicated to the finger on the slightest touch; while in cases of anæmia some pressure upon the artery is often required in order to make it evident.

A peculiar thrill or vibration is occasionally perceptible in the region of the heart, that must not be confounded with the phenomenon just described, and which arises from the direct friction of two rough surfaces during the motions of the heart: here it depends upon the friction between the opposed layers of the pericardium, which are roughened in consequence of the deposition of lymph upon them; the thrill has a different character from that of fremissement cataire, and is felt at a different part of the præcordial region. A somewhat similar feel is occasionally experienced when the hand is laid upon the side in cases of pleuritis or pleuro-pneumonia with false membranes; in bronchitis, likewise, when the sonorous râle is loud, a sensible vibration is sometimes communicated to the hand: in the latter cases, however, it accompanies the respiratory movements, not the heart's action.

SIGNS FURNISHED BY PERCUSSION.

The præcordial region includes the whole of that portion of the chest beneath which the heart is situated; and, in a healthy subject with a well-formed chest, the extent of surface in this region which yields a dull sound on percussion is limited. We have seen that the lungs are in contact with the greater portion of the anterior surface of the thorax, and, of course, wherever they are, the sound elicited by percussion will be clear. Where the anterior margin of the opposite lungs separates from one another, the anterior surface of the heart comes in contact with the thoracic walls, being only separated by the pericardium and cellular tissue.

The portion of the heart uncovered by lung is very small, seldom exceeding two inches in any direction: it has a triangular shape—the base below, the apex above; it consists of a portion of the apex of the right ventricle, and of part of the left ventricle near its apex, and is seated on a plane below the nipple and the fourth left rib: its base is on a line with the cartilage of the sixth left rib; its apex is at the point where the margins of the opposite lungs begin to separate from one another; its right boundary (which is constituted by the thin edge of the right lung) is nearly a vertical line through the centre of the sternum; its left boundary (which is constituted by the thin margin of the left lung) is an oblique line through the cartilages of the fifth and sixth left ribs.

This, then, is the only portion of the heart which in the healthy subject is in contact with the parietes of the chest, and it is the only portion of the præcordial region which yields what can be termed a dull sound on percussion. It is not, however, quite correct to term this a dull sound: it is less dull than that yielded by the hepatic region: the liver being a solid organ, and the heart hollow, the sound elicited by percussion over the former is more dull than over the latter. Indeed, as Dr. Latham* observes, "percussion here conveys to the ear a sense rather of less resonance than of positive dullness." "If the percussion used be but of moderate force, you must listen attentively to make sure that the resonance is really less here than elsewhere. It is only when the percussion used is of a force somewhat painful to the patient, that the ear begins to acknowledge a positive dullness." On strong percussion, likewise, a difference in the sound can be detected where the thin margin of the lungs covers the heart. The sound here is intermediate between the clear sound heard on percussion over the lungs, and that yielded by the part of the præcordial region where the heart is in contact with the parietes of the chest. We can thus, as M. Piorry remarks, trace the vertical and transverse diameters of the heart, and we can measure its size from above downwards, and from side to side The extent of the surface of the heart which is naturally in contact with the parietes of the chest is diminished somewhat, it must be recollected, in the supine posture; still more by taking a full inspiration. It is increased by leaning forward, and still more by a forced expiration.

In employing percussion in cases of disease, we may commence the examination of the præcordial region either above, below, or laterally; we may trace the sounds yielded by the lungs above and upon each side to this region; or, commencing below, we may trace the sounds from the region of the stomach, and of the left lobe of the liver, upwards. The mode of manipulation recommended by Dr. Hope† is "to lay one finger over the decidedly dull part, and another over the slightly resonant edge of the lung, when, by striking the two fingers alternately, the arched line along which the organ lies in contact with the walls may be traced with surprising accuracy, unless the subject be remarkable for obesity, which obscures the resonance." "In females, the mammæ may be pushed upwards, which generally leaves the dull portion sufficiently accessible."

Alterations in the extent and degree of the heart's superficial dulness.—The extent of surface in the præcordial region which yields a duller sound than natural on percussion is seldom diminished, owing to diseased states of the heart; but it is very often enlarged, while the degree of dulness is not unfrequently at the same time increased. The space will be diminished if the heart is congenitally smaller than natural, or if the lungs are largely developed; and it will disappear if the anterior margin of both lungs is emphysematous, and their edges meet in front of the organ. But, as the heart is generally somewhat enlarged under the latter circumstances, a portion of its anterior surface will still come in contact with the parietes, but the space which yields a dull sound will be on a plane somewhat lower than natural.

The region of the heart's superficial dulness will be increased whenever the heart is enlarged, or whenever fluid to any amount is effused into the sac of the pericardium; in the latter case the degree of dullness will be likewise much more marked. Thus, if the walls of the ventricles are hypertrophied, or if their cavities are dilated, a dull sound will be elicited by percussion over a wider surface; and the extent of this surface will be in some degree a measure of the increased size which the organ has attained: the enlarged heart pushing aside the lungs, and a larger portion of it coming in contact with the parietes in the præcordial region. When the two foregoing conditions are combined, the heart attains the largest size that it is capable of, and the præcordial region may yield a dull sound over a square surface of from four to six inches, in place of two. When the hypertrophy predominates over the dilatation, the space which yields a dull sound is greatest from above downwards; when dilatation predominates over the hypertrophy, the region in which a dull sound is yielded is greatest transversely. In pericarditic effusion, likewise, a large surface in the præcordial region yields a dull sound, while the degree of dulness is much more pronounced, and the amount of fluid effused may be pretty accurately measured by the extent of the dulness on percussion.

When a dull sound is elicited by percussion over an extensive surface in the præcordial region, the situation in which it is most marked, and the amount or degree of dullness, will be a guide as to its cause. When it depends upon enlargement of the heart, the site of the dullness is lower down, and more to the left side, than when it depends upon liquid effused into the sac of the pericardium. As the pericardial sac extends upwards to a level with the articulation of the second rib on the left side with the sternum, and sometimes, as I have found to be the case, as high as the first rib, if a large amount of fluid is contained in this sac a dull sound will be elicited by percussion as high as this point; while the degrees of dulness on percussion over a fluid is always much more marked than over the heart itself. It is said that hypertrophy may be distinguished from simple dilatation of the ventricles by the degree of resistance to the fingers employed in percussion being greater in the former than the latter; but there are other and better signs by which these conditions of the heart may be distinguished.

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* Lectures on Diseases of the Heart, Vol. i.

† Treatise on Diseases of the Heart, 4th edit.

The results furnished by percussion are, however, sometimes doubtful; for instance, when the margins of the lungs are emphysematous, and approach each other in the præcordial region, a clear, instead of a dull sound will be yielded in the natural situation of the heart's superficial dullness. When the lungs are solidified, either as the result of pneumonia or of tubercular infiltration, or from any other cause, a dull sound will be yielded upon each side of the heart over a considerable surface. When the heart is displaced, owing to liquid effusion into either pleura, or to some morbid growth in the cavity of the thorax, the region of the heart's superficial dulness will be altered.

Conclusions respecting percussion of the præcordial region.

1. The region of the heart's superficial dulness in the healthy adult subject does not exceed two inches in any direction. This space is on a plane below the nipple and the fourth left rib; its centre about the middle of the cartilage of the fifth left rib.

2. The sound elicited by percussion here is not absolutely dull unless pretty strong percussion be used.

3. The region of the heart's superficial dulness may be diminished, or it may be increased, or the degree of dulness may become more marked, owing to disease. It is much more frequently increased than diminished.

4. It will be diminished if the heart is naturally small, or the lungs are large and overlap the organ; and it may disappear if the anterior margin of both lungs is emphysematous.

5. It will be increased whenever the ventricles are hypertrophied, or their cavities are dilated, or when fluid is contained in the pericardial sac.

6. The seat of the diminished resonance always extends higher up, and is more extensive, as well from above downwards as laterally, when much fluid is contained in the sac of the pericardium, than when hypertrophy or dilatation of the heart exists.

7. The degree of dullness is always much more pronounced when fluid is contained in the sac of the pericardium than when the heart is enlarged.

THE

PATHOLOGY AND TREATMENT OF CONVULSIVE DISEASES,

BY R. B. TODD, M.D. F.R.S.

Introductory remarks—Definition of Convulsion—Subdivision of convulsions—Choreic—Tonic or tetanic—Clonic or epileptiform—Chorea typical of the first class—Choreic convulsions in gouty and rheumatic states, in white softening of the brain—Tetanus typical of the second: to be classed with it, Trismus nascentium, and Laryngismus—Epilepsy typical of the third, including convulsions of infants, puerperal convulsions, convulsions from renal or hepatic disease. Clinical history of chorea, two varieties, general and partial—Acute chorea—Non-symmetrical character of the choreic movements—Peculiar movement of the tongue—Paralysis following chorea, and preceding it—Disease of the heart accompanying chorea; this due to rheumatism—Choreic patients often of the rheumatic diathesis—Chorea not a fatal disease—Affections analogous to chorea—Peculiar affection of the hand—Fidgets of children—Points in the clinical history of Tetanus—Clinical history of Trismus nascentium—Of Laryngismus stridulus—Of Epilepsy, phenomena accompanying the fit—Paralysis after epilepsy—Acute Epilepsy—may occur without morbid lesion of the brain—Convulsions of infants—Toxic epilepsy—Puerperal convulsions.

Through all science which depends upon, and, as it were, grows out of observation,—out of the observation not of to-day or yesterday, but of years and ages,—it is of vast importance that its cultivators should from time to time review the existing state of knowledge, examine well the bases on which it rests, and inquire whether the foundation be secure, and whether any change, either by addition or subtraction, should be made in the superstructure: as they to whom is confided the custody of some time honoured edifice, planned, it may be, by the constructive genius of one man, but reared by the laborious industry of many, at various periods diligently inspect its foundations, search for such defects either in them or in the superstructure, as the less perfect architecture of a previous age may have suffered to exist, and supply these defects by alterations or additions suggested by the progress of knowledge, and the accumulation of experience.

Great advances have been made of late years in our knowledge of the physiology of the nervous system. We can now study the morbid phenomena of that system by the light which a more exact anatomy and physiology of it throws upon it, and likewise with the most important and valuable aid of larger views of pathology, and a more intimate knowledge of the various causes, whether external to, or inherent in the body, which are capable of disturbing the normal action of the nerves or the nervous centres.

On this account I have chosen as the subject of these papers a class of diseases, still obscure, but which the progress of general pathology seems likely to rescue from the darkness in which they have hitherto been shrouded. I propose to discuss the pathology of those diseases of which that kind of muscular action, to which the term *Convulsions* may be applied, is, if not a constant symptom, at least a very frequent one, and *the prominent one* when they are present.

It will be necessary for me to state *in limine*, that under the general term *Convulsion* I include all those irregular actions of sets of muscles which are wholly unrestrainable by the influence of the will, and which are excited and kept up by a physical irritant. Thus if the flexors of a limb are thrown into action of this sort, I would say they are convulsed, designating the peculiar mode of convulsion with which they are affected, and so also with larger sets of muscles, and the entire muscular system.

Under this definition of the word convulsion I would refer to three distinct kinds of convulsions, each of which denotes a different cause, and is produced by an affection of the nervous system distinct in kind as well as in position. These are, the jactitating, or chorea-like, or choreic; tonic, or tetanic; clonic, or epileptiform.

The first kind are peculiar jerking movements affecting the muscles of a limb, or of one side of the body and of the face: the movements are exceedingly irregular, wholly uncontrollable by any effort of the will, and only affected by it in this way, that an effort of the will directed upon the disordered muscles tends not to restrain, but greatly to augment the disturbance. There is in general no augmentation of power in the choreic convulsion; on the contrary, it is accompanied by a state of great debility and of imperfect muscular nutrition: sometimes it is preceded by a paralytic state, and not unfrequently it is succeeded by it. If any attempt be made to restrain the convulsive movements, they immediately become increased in force and frequency, and there is danger that under a continuance of the restraint a partial or limited convulsion may be converted into a general one. Lastly. The choreic convulsions, however general and rapid, are controlled in the most perfect manner by sleep.

The second, or tonic or tetanic convulsion, is a state of greatly increased muscular tension, which never experiences any complete relaxation, but every now and then undergoes a sudden increase of tension. A muscle thus convulsed may be compared to the string of a violencello, screwed up to concert pitch, and from time to time made more tense by a sudden turn of the regulating screw, which gradually allows it to return to its former tension. In these convulsions there is doubtless a preternatural development of the muscular force, to such an extent that some of the fibres become ruptured by their own force of contraction. Convulsions of this kind may be exactly imitated by the transmission of the galvanic current in rapid succession through the spinal cord, or by the continuous transmission of the *inverse* current for half an hour through a limb; when, upon the interruption of the current, the muscles of that limb suddenly assume the tetanoid state, which last for a few seconds,—or they may be developed by the poison of strychnia.

The third, or clonic or epileptic convulsion, consists of powerful active contractions of sets of muscles, resembling a succession of forcible voluntary contractions. Each act of contraction is rapidly succeeded by a state of relaxation, and again as rapidly followed by a fresh contraction, and so on until the muscular force is well nigh exhausted, or the exciting force is worn out.

The power of these contractions is always great, sometimes extraordinary; so that the combined effort of several strong men is inadequate to hold the patient down: this kind of contraction is not favourable to the rupture of the muscles, but bones are sometimes broken in the epileptic convulsion. I have known even so strong a bone as the femur to have been broken by the muscular struggle.

Having thus defined the nature of the three forms which, I believe, include every variety of disturbed muscular action to which the term convulsion can be applied, I shall proceed to enumerate the various diseases which are characterised or accompanied by these unnatural manifestations of muscular force, and then take a rapid glance at the main features of their clinical history, which will form the premises whence we are to draw our conclusions regarding the pathology of these diseases.

The first class of convulsions is met with in the typical malady, chorea, and in states resembling chorea, although differing from it in many particulars.

The only other conditions under which such convulsions take place, so far as I am aware, are in particular rheumatic and gouty states, and in white softening of the brain, connected with, and probably arising from, a morbid state of arteries.

The type of the second class of convulsions is that formidable malady, Tetanus, the clinical history of which, as resulting generally from wounds, is now so well known.

Along with this I would class that remarkable affection which attacks infants, which has received the various designations of spasmodic croup, cerebral croup, *Laryngismus stridulus*.

The disease called *Trismus nascentium*, better known in the West Indies than in this country, is also very nearly allied to, if not identical with, tetanus.

I would name Epilepsy as typical of the third class of convulsions, and in the same category with it would come the common convulsive fits of children, the convulsions which affect puerperal women, &c.

My remarks on the clinical history of these various maladies will be made in the order in which those diseases have been referred to.

And first, of Chorea.—The disease is one of early life, very rarely occurring after puberty has been well established; and if it do occur later than the ordinary period of life, when the signs of puberty are developed, it is generally found that those signs have not as yet distinctly manifested themselves in the patient. The period to which chorea is most properly restricted is that between 6 and 15 years of age. Of 189 cases observed by Rufz in the children's hospital at Paris, 10 only occurred before 6 years; 179 between 6 and 15; and of the latter number, 118 occurred between 10 and 15.

It affects girls in much greater proportion than boys. Of the 189 cases collected by Rufz, 138 were in girls, 51 in boys.

The muscles affected in this disease are all those connected with the cerebro-spinal nervous system,—those of the head, face, trunk, and extremities. It is very doubtful that even the so-called organic muscles ever suffer; and if the heart is involved at all, its affection is probably of an entirely different kind, and takes place in a different manner from that of other muscles.

The examination of the phenomena of a great number of cases of chorea will show that the disease exhibits two varieties, namely, general chorea and partial chorea; and that the former may be either acute or chronic.

General Chorea.—In *general chorea* the whole external muscular system is involved; the patient is unabled to stand or walk; speech is either quite destroyed, or so inarticulate that it is impossible to understand what is said,—such is the disturbed state of the muscles that no voluntary action can be properly performed. The tongue is protruded with the same peculiar jerking effort which accompanies all the other muscular actions; and one wonders that, as it emerges from the mouth, it escapes being injured by the teeth, which the irregular actions of the masticatory muscles press convulsively against it.

The patient, unable to stand, is obliged to remain in bed; and there tosses from one side to another, sometimes rolling incessantly to such an extent that the friction of the most prominent parts of the body against the bed causes stripping and ultimately troublesome sores. And when the agitation is violent, these patients literally shake themselves to death, which is brought on by the exhaustion induced by these unceasing movements.

When the convulsive movements are so violent and unceasing as I have now described them, the disease may be called *acute*, for it must destroy the patient, or cease, in a few days.

Happily, however, this form of the disease is rare, and general chorea occurs most frequently in a more chronic form; the movements, however, being of the same character, less frequent and less active, and with longer intervals of sleep, which restores the patient and provides fresh strength for new agitation.

Partial chorea.—The most common form of *chorea* is the *partial*. It is needless for me to enter upon any detailed description of the phenomena of a disease which must be so familiar to all my hearers. I will just point your attention to a few of its leading features.

1. The affection is not symmetrical, that is to say, one side of the body is more frequently affected than both; or if both should be affected, one is always much more so than the other. In general, this difference of affection of one side remains with that side whichever it may be; but in rare instances there is a disposition to shift, and for two or three days the right side will be chiefly affected, and then for a longer or shorter period the left side will exhibit the most active movements. This tendency to shift calls to mind a prominent feature of certain rheumatic and gouty affections.

2. Of all the movements which accompany chorea, that of the tongue is the most peculiar and characteristic; indeed I would call it pathognomonic. The patient protrudes the tongue with a peculiar thrust to the fullest extent of which it will admit; frequently this is done by one effort, at other times it requires two or three attempts before it can be accomplished. And the subsequent retraction is also peculiar: the tongue is drawn back, supported and guided by the pressure of the teeth, and often very slowly and with great caution. Sometimes this peculiar mode of protrusion of the tongue is the precursor of the other choreic symptoms; and if we had frequent opportunities of seeing the cases very early, I have no doubt that this symptom would be found more frequently the harbinger of the more extensive affection. I have, from this symptom only, been able to predict with accuracy that an attack of chorea was coming on.

3. The choreic convulsion is frequently succeeded by a paralytic state of the limbs previously convulsed; the convulsive movements cease, and the limbs remain paralysed; the paralysis is seldom complete, although considerable. When the choreic convulsion had affected one side, the paralysis will likewise affect the same side; it will be *hemiplegic*, and will resemble very closely hemiplegia from diseased brain, for which it is very apt to be mistaken by those not aware of this fact. Not long ago a boy was brought to my house for me to advise whether the hemiplegic paralysis under which he suffered should be treated by antiphlogistic means, such as mercury, &c. I soon discovered that the case was one of choreic paralysis, and advised steel and shower baths, and

exercise of the limbs; under which he rapidly recovered.

In a very few instances paralysis *precedes* the choreic convulsion, but so far as my observation informs me, it is then accompanied by the peculiar thrust of the tongue; by this sign I have been enabled to distinguish it.

That paralysis may occur in this way is evidently a fact of the highest practical interest, whilst it is not devoid of importance as bearing upon the pathology of the disease. Nevertheless I do not find it noticed in any of the descriptions of the disease in the practical works which I have consulted. The previous history of the case, the absence of any other symptom referable to the head, and the gradual mode of invasion of the paralysis, in addition to the peculiar mode of protrusion of the tongue, will always enable the careful practitioner to distinguish this paralysis from that caused by cerebral lesion.

4. The heart is very frequently morbidly affected in chorea; and this morbid affection shows itself, not in any disturbance of *the rhythm* of the heart, which, so far as my observation extends, never is disturbed, but in a derangement of its sounds. A bellows sound is frequently present, and is either aortic systolic, when it is almost always an accompaniment of the anæmic state of the patient, but *much more frequently* it is *mitral systolic* or *regurgitant.*

I am surprised that this feature of the clinical history of chorea has not attracted more general attention. It has been well known to me for many years, and I described it in the Croonian lectures on the pathology of rheumatism, which were given by me in this theatre six years ago. But to my friend, Dr. Addison, of Guy's Hospital, is due, so far as I know, the merit of having first made public the frequent occurrence of this bellows sound in chorea.

What is the cause of this sound? is it due to any irregularity in the muscular action of the heart? a choreic state of that, as of the external muscles, whereby the action of the valves is disturbed? or is it caused by a morbid deposit on the mitral valves, which prevents their precise action; or can it, like the aortic sound, depend on the anæmic state of the patient?

I shall answer the last question first. The closure of the mitral valves is the result of the mechanical accumulation of fluid in the ventricle, which presses the valves towards the auricle, their tension being maintained by the chordæ tendineæ: this effect will be produced no matter what may be the nature of the compressing fluid; a mere colourless state of the blood cannot produce mitral regurgitant bellows sound; some imperfection, either of the valves themselves, or of their mode of apposition, must exist in order to produce such a phenomenon.

It is plain, then, that the bellows sound must be caused by some disturbance in the action of the mitral valves. What, then, produces the valvular derangement? Can it be any disturbance of the muscular action of the heart, any choreic state of the musculi papillares? I apprehend not; for as the closure of the valves is not accomplished by the action of the muscles, it would not be affected by any such irregular muscular action. Moreover, no such choreic state of the heart's action could take place without its being indicated by a disturbance of the heart's rhythm, which, of course, would be very readily detected.

Hence, then, we cannot resist the conclusion, that the mitral bellows sound in these cases is due to such an organic lesion as prevents the complete closure of the mitral valves during the systolic effort of the heart.

But now we are met with another question not less important. What can have created this morbid state of the mitral valves? It is rare to meet any symptom of heart affection, either preceding or accompanying the chorea; and the valvular imperfection is often overlooked, and only discovered by careful auscultation of the heart's sounds.

The true answer to this question is, I believe, to be found in the fact that many of the patients who suffer from chorea are of a rheumatic diathesis, and that in consequence of this rheumatic state they experience an insidious endocarditis which generally affects the mitral valves.

The proof that rheumatic diathesis and chorea are frequently met together, is derived from these facts,—that many of the sufferers from the latter malady, when carefully examined, are found to have previously suffered more or less from chronic articular pains, to have sprung from rheumatic or gouty parents, and to exhibit deranged secretions, such as occur in rheumatic states. I have seen many instances of choreic children passing urine of high specific gravity, loaded with lithates, and sometimes precipitating lithic acid in very notable quantity, and for a considerable time. Choreic patients often suffer from rheumatic fever; and, as the subjects of that fever are very liable to its recurrence, so a child who has once had chorea is apt to have it again and again.

The history of the following case will serve as an illustration of the kind of connection which sometimes exists between chorea and rheumatic fever.

Alfred Brewer, æt. 14, had good health until his eighth year, when he had an attack of rheumatic fever. Four months after this he became affected with general chorea. He was cured of this in seven weeks. A year afterwards he had a second attack of chorea, which affected the left side chiefly. From this time he continued well for four years, then he had another attack of rheumatic fever, which lasted three weeks, and six weeks after this he was seized with his third attack of chorea.

Chorea does not occur in children whose nutrition is in a healthy state, but in those whose digestive powers are feeble, or who are badly fed, either by too abundant and ill-adjusted diet, or by food defective both in quantity or quality. It is not unreasonable to expect to find many rheumatic subjects among such patients, especially among the children of the poor, who are exposed to the inclemencies of the weather.

Lastly, the history of chorea shows that its natural tendency is to recover, and that it very seldom proves fatal. Of the 14,725 deaths which occurred in London in the quarter ending at Christmas 1848, only one was from chorea; and, in the corresponding quarters of the seven previous years, the deaths from the disease did not exceed one, excepting in the year 1844, when there was the curious exception of six deaths from chorea registered; and in 1845, there was no death from that cause.

When we take into account the large number of children affected with this disease, as the records of every hospital and dispensary will show; and when we remember how many of these cases are neglected, left solely to nature, receiving neither care nor medical assistance,—we are fully justified in laying it down as a feature of the disease, that its natural tendency is to get well.

Whatever morbid disturbance may take place in any of the internal organs calculated to give rise to chorea, it may be presumed from the facts I have detailed, that it is not such as does not admit of easy amendment; and the few post-mortem examinations on record of patients dead of this disease, show that it leaves behind it no trace of any lesion in any organ of the body likely to produce it. In some of the cases no morbid lesion of any kind could be detected; and it cannot for a moment be imagined that the slight opacities of the arachnoid, the effusion of liquid in the spinal canal, the marks of chronic ovarian disease, noticed in other cases, could at all have the relation of a cause to the phenomena of the disease. How many hundreds of spinal effusions, or opaque arachnoids, or irritated ovaries, have there been without the slightest indication of chorea!

So far for such points in the clinical history of chorea as may serve me as a basis for my argument respecting its pathology.

I have already stated that movements analogous to those of chorea may occur in rheumatic or gouty states. I have known such affections of the upper, and more rarely of the lower, extremity. The affection consists in a sort of fidgetty restlessness of the limb, and a difficulty, and sometimes an impossibility, of accomplishing certain actions with anything like accuracy or precision. In the cases which have come under my own observation, there has been a considerable development of the gouty constitution.

There is a curious affection, of which I have met with two examples in my own practice, and of which five or six have been recorded by Albers of Bremen: the prominent feature of it is the inability to hold a pen and to write for any time. The patient begins to write—writes two or three words—when the hand forthwith is spasmodically extended, the fingers cease to be controllable, and the pen falls away from them. If the patient attempts to control his pen hand with the other hand, or if any one else does it for him, the movements become worse, and he suffers excessive pain up the arm; yet all other actions are well done, and the power of the hand to grasp is good. One gentleman thus affected is a man of considerable mental endowments, and he has found it so impossible to overcome the irregular movements of his hand, that he has trained himself to write with his left hand, which he can now do with such facility, that he can carry on an extensive correspondence.

There can be no doubt that the impairment of speech, which is sometimes a forerunner of cerebral mischief, and which ought always to be regarded as a warning of such an invasion, is of this character. Emotional excitement will cause hesitation of speech in many healthy persons; many can do certain things very well if allowed to take their own time, but if hurried and flurried they are apt to bungle about them very seriously.

In one instance I found well marked choreic convulsions of the right arm, with disturbed intellect, and gangrene of the toes, associated with extensive colourless softening of the left cerebral hemisphere, involving the optic thalamus.

Allied to the movements of chorea are the fidgets of children, and, perhaps, also those of grown persons. In some children these fidgetty movements are so excessive that the child becomes almost a nuisance in a room. All the muscles are affected; the child incessantly makes grimaces of the most various kinds; every minute he assumes a new attitude; if anything comes in his way he must handle or touch it; and these irregularities are always the greater when there is derangement of general health. Children thus affected might readily be thrown into the convulsions of chorea by a strong mental emotion.

My second class of convulsive affections is typified by the well-known malady, Tetanus.

The points to which I would beg your particular attention in the clinical history of this disease are these:—

1. The little variation of the symptoms in different cases of tetanus as compared with each other. If you see one well-developed case of tetanus, you have seen all; the variations are only as to the degree of tetanic convulsion; in all you have the tetanic face, the rigid limbs, the locked jaw, the opisthotonos. In the acute form of the disease, indeed, the malady runs its course with much greater, sometimes with extraordinary rapidity; while in the more chronic form it lasts a fortnight or three weeks, and in a few a much longer period.

2. The fact, now abundantly proved, that these symptoms occur without any lesion of the nervous system appreciable by aided or unaided vision; and what is equally remarkable, the artificial tetanus (if I may so speak) caused by the administration of strychnine in large doses, occurs equally without the slightest lesion of any part of the cerebro-spinal axis. I have examined, with the most scrupulous care, the spinal cords of rabbits which died in strong tetanic convulsions, kept up for some time after by large doses of strychnine, but I could not discover, even with the highest powers of the microscope, any indication of deranged structure.

3. The curious and interesting fact, that tetanus often appears endemically, and its development is favored by some localities much more than by others. Thus it is well known that the disease, not only in its traumatic but also in its idiopathic form, is much more common in the West Indies than in more temperate climates; and it seems pretty well proved that under modern improvements in diet, ventilation, and cleanliness, as well as under a better mode of treatment of wounds, the disease has become much less common in that climate than formerly. Even in this country we meet with curious instances of several cases occurring in rapid succession in the same locality from exciting causes, which, although themselves frequent and common, have rarely before been followed by the same results.

4. The tendency in tetanus is to death by exhaustion and asphyxia. The frequent return of the attacks of spasm, affecting all the muscles of the trunk, have a most exhausting influence upon the patient; and as the respiratory muscles, and even the muscles of the larynx, are generally more or less involved, the respiratory function becomes seriously impeded. Hence, the most fatal sign is a rapid recurrence of the convulsive attacks, and the most auspicious sign is the prolongation of the intervals between them. Practically the disease should be regarded as one of extremely fatal tendency, and therefore requiring the diligent interference of art to counteract its debilitating influence.

The disease called *Trismus nascentium* is essentially the same as acute tetanus affecting infants, and due to a peculiar state of system developed under deleterious local influences. Under modern improvements in diet, cleanliness, and ventilation, this disease is rapidly vanishing from this country, and has diminished considerably even in the West Indies. Dr. Clarke, by means of good ventilation, reduced the mortality from this disease in the Dublin Lying-in Hospital from seventeen per cent. to five or six; and in Dr. Collins' mastership of the same hospital, extending from 1826 to 1833, the mortality from this disease had fallen to a mere fraction per cent.;* and Dr. Colles states that by adopting the plan of plunging the infants daily in cold water, and dressing the umbilicus with turpentine, the disease, on a particular estate in the West Indies, from having been exceedingly frequent, became so rare as scarcely to be met with.

I have classed with the diseases accompanied by tetanic convulsions, that curious, and sometimes highly dangerous disease of infants, the laryngismus stridulus, as it is now generally named, because it has many points of resemblance to tetanus, and because I am of opinion that its pathology is essentially the same with that of that disease.

The features of this disease to which I beg your particular attention are these—

1. That the laryngeal spasms are truly tetanic, and occur in paroxysms: differing, however, from the ordinary tetanus in this, that a more complete relaxation of the muscles takes place in the intervals between the paroxysms, and that a considerable period often elapses before a recurrence of the paroxysm takes place.

2. As in tetanus the paroxysm is brought on by the sudden application of external stimuli, as by a sudden draught of cold air, a start, by sudden mental emotion, by the attempt to swallow, so the same causes tend to produce the paroxysm in the laryngismus.

3. Tetanus sometimes does not extend beyond the muscles of the jaw and throat: this is more frequently the case with laryngismus, but very frequently in the latter disease the tetanic convulsion extends to other muscles: the muscles of the extremities become engaged, and the so-called *carpo-pedal* spasm is induced; the limbs being stiffened, the wrists flexed, the thumbs turned in, and firmly bent into the palm of the hand, and at the same time a similar condition of the ankle and foot, and an inversion and flexion of the great toe. With these there is frequently well-marked opisthotonos, sometimes not extending beyond the cervical and dorsal regions, sometimes affecting the whole spine. During the paroxysm the child's consciousness is unaffected, and after its cessation the child returns to its previous state, appearing no otherwise changed than being more or less exhausted by the greater or less violence of the paroxysm.

4. Laryngismus does not manifest itself in robust and healthy children, but in children often weakly, but always in a state of depraved nutrition, from irregular and imperfect feeding, bad air, and frequently from the irritation of teething. A strong, healthy, well-fed child never exhibits laryngismus. Frequently the similarity of nervous constitution, as well as the mode of dieting of children in the same family, favours the development of the malady in successive brothers and sisters about the same period of infancy; and hence we often hear of instances of seveal members of the same family having been carried off in infancy by this malady.

5. There can be no doubt that under the continued operation of the exciting causes of the disease, laryngismus tends to a fatal result. It exhibits no spontaneous tendency to recover. Death takes place in some cases apparently from rapid asphyxia, much in the way it sometimes does in the cases of rapid development of œdema glottidis, or from the attempt to respire carbonic acid gas; generally the infant dies from exhaustion, brought on by the frequency of the paroxysms, and augmented by the injury to the respiratory function which each paroxysm causes. In such cases the mode of death is exactly as in tetanus. But in a third class the long continuance of the impaired nutrition generates a morbid state of brain, epileptiform convulsions are superadded to the tetanic convulsion, and dropsy of the ventricles takes place, favoured by the retardation to the venous circulation which these frequent attacks

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* See Collins' Midwifery, p. 513.

occasion, and also, sometimes, by the deposit of tubercular matter in the course of the venæ magnæ Galeni which return the blood from the ventricles and the choroid plexus; and thus the patient dies with all the phenomena of hydrocephalus.

I come now to notice the clinical history of a class of convulsive diseases which is far more common and much more formidable in appearance than any of the others to which allusion has been made, but which is much less fatal than those of the tetanic kind.

And I shall take first the typical malady—*epilepsy*. This disease is characterised mainly by the occurrence at intervals sometimes remarkably uniform in duration, of attacks of loss of consciousness, frequently sudden, often preceded by some kind of warning. These attacks last for a longer or shorter interval, when the patient recovers, as if awaking from a sleep, but continues in a drowsy state for a variable term.

In by far the greatest number of instances these attacks are accompanied by a loss of *voluntary* and *locomotive* power, so that the patient, on the supervention of the attack, falls down, and is thrown into convulsions of the character which I have already described by the name of epileptiform convulsions. These continue for some time—they subside—the state of insensibility remains—and for a variable time the patient continues in a profound sleep, or in a state of heavy drowsiness.

The phenomena which precede the fit vary infinitely, not only in their nature, but in their intensity and in their duration. In by far the majority of cases the precursory symptoms of an attack consist in a disturbed state of sensation, or of intellectual action. Thus the patient has headache, or a sense of giddiness, or some altered state of vision, causing motes or flashes of light, or other more complicated ocular spectra. Sometimes hearing is affected: the patient complains of tingling in the ears, and noises in the head. Or smell may be disturbed, as in the case mentioned by Heberden, where a smell of musk ushered in the attack.

The more complicated precursory phenomena also illustrate my position: thus with one of my patients the warning came on five minutes before the attack, and consisted in a feeling of terror, with violent tremors, and the fancy that he saw persons coming up to him and impeding his attempts to move on. Dr. Watson quotes from Dr. Gregory the curious instance that with a patient of his the warning consisted in the phantom of a little old woman in a red cloak coming sharply up to him and striking him on the head.

Not unfrequently before a fit the patient becomes delirious, sometimes raving mad; then comes the regular paroxysm, and when sensibility returns, the delirium again sets in, and remains for some time. The knowledge of this fact lately saved me from what might have proved a serious interruption and inconvenience. A gentleman, who had had one or two paroxysms of epilepsy, came to my house one morning to consult me: having talked quite sensibly for a short time, he suddenly seemed to lose himself, and then talked incoherently. This excited my alarm: I sent for a cab, and went home with him, and had just arrived at his door when he was seized with one of the most violent and one of the longest fits I ever saw.

The aura epileptica is a disturbance of sensation; but it is remarkable how extremely rarely this phenomenon, so often referred to by writers, is met with. It very seldom happens that we meet with an example of it presenting even a near approach to the description given of it by writer after writer.

The loud unearthly shriek which often ushers in the fit is probably excited by some sudden disturbance of sensation—some severe pain—which causes the patient to cry out, but which the sudden invasion of the epileptic state dissipates from his memory.

In most cases of epilepsy all the voluntary muscles are engaged, but in many instances those of one-half the body are much more convulsed than those of the other, and in some the convulsions are altogether limited to one-half the body. I have frequently seen the most intense convulsion of the arm and leg and side of the face on one side, while the corresponding parts on the other side were perfectly quiescent. The action of the heart is very much accelerated in the fit; the terror which its approach induces greatly excites this action, and this excited state continues for some time after the fit has subsided. A dilated condition of the pupil almost invariably accompanies the fit, however slight it may be.

Epilepsy is a disease of all periods of life: it seems not improbable that it may commence even *in utero*, being first developed by some powerful emotion excited in the mother, or due to some other disturbing influence upon the nervous system of the embryo.

Bouchet and Cazanvielh, from sixty-six observations, obtained the following results regarding the periods of life at which epilepsy is most apt to occur:—that from birth to 5 years there were 18 epileptics (9 being congenital;) from 5 to 10 years, 11; to 15, 11; to 20, 10; to 25, 5; to 30, 4; to 35, 1; to 40, 2; to 45, 1; to 55, 0; to 60, 1.

A paralytic state remains sometimes after the epileptic convulsion. This is more particularly the case when the convulsion has affected only one side or one limb: that limb or limbs will remain paralytic for some hours, or even days, after the cessation of the paroxysm, but it will ultimately perfectly recover. This is a form of paralysis in a great degree analogous to that of chorea.

There is an acute form of epilepsy, as there is a chronic form also. The acute form is distinguished by the number and violence of the fits, and the rapidity with which they succeed each other: so violent are the fits, that they exhaust, and if long continued, kill the patient. I have seen patients exhibit a rapid succession of fits for a whole day, with intervals of not more than five or ten minutes, and the exhaustion induced by them has been so great that I have been forced to give stimulants in large quantities to keep the patient alive.

In the chronic form the disease is remarkable for the kind of periodicity which regulates the development of the paroxysms: thus the fit will occur once in 24 hours, or once in 48 hours, or once a week, or once a month, but not with unvarying exactness as to the interval, nor without many disturbances to the ordinary rate of its occurrence. Although this periodicity exhibits some analogy to that of ague, it wants greatly its precision.

Of the tendency to the propagation of epilepsy by hereditary descent there can be no doubt. Cazanvielh and Bouchet make this remarkable statement: 14 epileptic mothers had 58 children: of this number 37 died, the eldest at 14, the rest nearly all of convulsions; 21 were living, of whom 14 were healthy, still young, and 7 already epileptic.

Epilepsy seldom kills: in the record of deaths we meet comparatively few deaths from that cause: epileptics die nominally of other diseases: they are liable to the vicissitudes of other men—accidents, and consequent injuries, not unfrequent (and to these their epileptic condition peculiarly exposes them,) fevers, diarrhœa, cholera, &c. These dispose of a large number of them; but a considerable proportion gradually fall into dementia or other forms of insanity, and then they become classed with the insane.

The tendency of epilepsy is to the destruction of the nervous force, in the brain especially, but ultimately throughout the whole cerebro-spinal centres. The earliest indication of the failure of the nervous power is in the weakening of the perceptive powers and of the memory. No doubt the power of attention suffers primarily, and then the retentive faculty becomes damaged. In this way only can we explain the fact that the power of memory for events of *recent* occurrence suffers first, the patient recollecting old events, or facts stored in the mind at a remote period, as well as ever. Ultimately, however, the memory of events of all kinds and at all periods is lost, and the patient becomes fatuous. This failure of the intellectual powers takes place the more rapidly as the paroxysms are more frequent and more severe: it will occur more surely where the fits have been accompanied with much mental disturbance or stupor, than where the convulsive character predominates. Frequent attacks of the epileptic vertigo of Esquirol—*the petit mal*—are in general pretty certain precursors of a state of dementia or fatuity.

It is an important feature in the clinical history of epilepsy that the fits sometimes cease spontaneously, or without any cause which can be recognised. Many a remedy for epilepsy has acquired the credit of curing the disease, when it has happened to be exhibited in a case in which this spontaneous tendency to recovery has manifested itself.

Epilepsy and insanity frequently go together: in some cases the epilepsy precedes, and, as it were, induces the insanity; in others the insanity has the precedence; and in a third class the patients are insane only for a short time before, and for a short time after, the epileptic paroxysm, and then resume a tolerably healthy state of mind until the access of the next paroxysm.

A remarkable and most interesting point in the clinical history of epilepsy is that it may go on for a considerable time, even in its most acute form, without the existence of any morbid change in the brain to be recognised by our means of examination.

Nothing is more certain than that not only one, but several paroxysms of epilepsy may be induced in a person whose brain and spinal cord present all the ordinary appearances of health.

The congestion which is apparent in the brains of epileptics, but which is seldom present excepting in those who have died in the fit, or very shortly after it, is attributable entirely to the impediment to respiration, and consequently to the venous circulation, caused by the epileptic struggle. When death has not been immediately consequent upon a fit, the appearances indicate rather that the brain has not been supplied with its usual amount of blood, and that whatever congestion may exist is found in the veins. Those bloody points on the surface of the centrum ovale which are so often referred to by authors as indicative of a state of congestion are mostly the mouths of veins divided in slicing the hemispheres.

The opaque arachnoids, the enlarged Pachionian bodies, the adherent dura mater sometimes partially ossified, are often found where there has been no epilepsy, and are rather the signs of the altered nutrition brought on by any cause which creates frequent disturbance of the actions of the brain, than the causes of that disturbance. These morbid appearances are constant, but the diseased actions are periodical: it is therefore highly improbable that the lesions above described would develope the phenomena of the epileptic fit.

The brain itself also suffers in its nutrition; it diminishes in size, the convolutions become small, the sulci between them large: the subarachnoid fluid, which always, in point of quantity, bears an inverse proportion to the bulk of the brain, is increased in amount to a greater or less degree.

Whether tumours, the remains of old apoplectic cysts, spicula of bone growing from the interior of the cranium, indurations of portions of the brain, or the so-called hypertrophy of the brain, can give rise to that which has been called *centric epilepsy*, I must reserve for further discussion when I come to inquire into the pathology of this disease.

There are conditions remarkably resembling epilepsy, and not to be distinguished from it as regards the actual phenomena of the fit, but which occur under such constant circumstances that the paroxysm evidently is related to them as effect to cause. I allude to the convulsions of children—the convulsions induced by the introduction of some poison into the system, or the retention of some material in it which ought to be excreted as soon as formed as urea (the *epilepsia* or *eclampsia toxica* of some authors,) the convulsions of puerperal women (eclampsia parturientium.)

The ordinary convulsions of children resemble closely the epileptic paroxysm : in many instances, however, there is a great deal of tetanic convulsion combined with the epileptic convulsion. The unconsciousness of epilepsy is always present in the convulsions of children, and the torpor before and after the fit is rarely absent. Signs of the coming struggle are afforded in restlessness, peevishness, diminished intelligence, a heavy and torpid, but not a sleeping state.

Convulsions do not, in general, attack robust and healthy children, but those who are weakly and ill-nourished; not those who are furnished with a good supply of healthy blood, but those whose blood is poor in quality, and often deficient in quantity; children that are improperly or insufficiently fed; or in whom various resources of irritation exist—such as dentition, irregular secretions, &c. And it may be remarked that these sources of irritation favour the development of convulsions more by the disturbance which they create in general nutrition, in the state of the blood, and in the nutrition of the brain, than by any direct influence upon that organ through the nerves.

Of 28,378 deaths of children from infancy to 15 from all causes in London and its environs, in 1848, those from convulsions numbered 2047, or nearly nine per cent. The children in general die from exhaustion, worn out by the repetition of the fits; and, in the vast proportion of cases, anatomy discloses nothing to explain why convulsions should have existed before death more than other morbid phenomena. With proper care and attention to the child, convulsions have not necessarily a fatal tendency—no more than epilepsy; for, judging from the immense number of children who are attacked, the proportion of deaths to recoveries must be small; but on this point we have no accurate statistics.

Let me remark here, that such morbid appearances as are met with most commonly in the heads of children dead of convulsions, are attributable to the state of general disturbed nutrition of the nervous centres, as in epilepsy, and cannot be regarded as the *cause* of the convulsive paroxysm. The appearances to which I allude are increased sub-arachnoid fluid, or intra-ventricular fluid : they never exist together, as the one may be regarded as antagonistic of the other :—for the most part a pale state of brain, especially of the vesicular matter, with numerous bloody points, formed by the orifices of veins cut in slicing the brain. Now these are appearances constantly met with in the children who have died of other maladies, but in whom no convulsions had been present. Indeed, I think that the position will not be gainsaid, that the pathological state which favours the development of convulsions does not, any more than that of epilepsy, leave any signs which even the most experienced anatomist would recognise.

There can be no doubt that a large number of the cases of convulsions in children from infancy to fifteen years of age, are referable to the introduction into the blood, or the retention in it, of some new material, and therefore may be classed with the convulsions to the clinical history of which I am now about to refer.

So excitable is the nervous system of children, that the development of a fever, especially if caused by the introduction of a poison, is very apt to be ushered in by convulsions, which sometimes prove fatal, and certainly will be more likely to prove fatal if the treatment be conducted with the idea of suppressing the present evil, neglecting to look to what the child has to undergo after the convulsions have ceased. All practical men, are familiar with convulsions in connexion with the early development of small-pox, measles, and especially of scarlet fever.

An artificial epilepsy may be produced by the administration of certain poisons; as the œnanthe crocata, conium, and prussic acid. In poisoning by this latter substance, the epileptic convulsions are frequently complicated to a very great extent with those of the tetanic kind.

These facts prepare us for the doctrine that the retention of certain important excretions in the blood, which their proper organs are incapable of eliminating, favours the development of a state exactly resembling epilepsy in the phenomena of the convulsive fits. When the liver or kidney are in such a state that the elements of the bile, or those of the urine, are not separated in their normal quantity, the patient is very apt to have several convulsive fits, which often terminate his existence. Renal disease is a much more fruitful source of convulsions than hepatic, and the form of disease in which they are most apt to occur is in that small contracted kidney which by some is regarded as a stage of Bright's disease, but which, in reality, is a special morbid state of kidney, a chronic nephritis, frequently produced by gout, and therefore forming the finale of many a gouty patient's career, but often resulting from other causes. In this state of kidney, the gland has shrunk chiefly at the expense of the cortical substance; the growth of epithelium (the immediate agent in the separation of organic products) is greatly impaired, many of the renal tubes are stripped of it, and no development of epithelium at all takes place in them. Hence, while in many of these cases water is freely eliminated, and even a diuresis takes place of an urine pale, and of low specific gravity, the organic products, urea and uric acid, accumulate in the blood, and act, especially the former, as a poison to the nervous system. Any state of kidney, however, if it be unfavourable to due elimination, may give rise to these symptoms; and accordingly I have seen them in that acute affection of the kidneys which is associated with inflammatory dropsy, and with dropsy after scarlet fever, to which my friend Dr. Geo. Johnson, has given the appropriate name, *Desquamative nephritis;* and also in fatty disease of the kidney, where the accumulation of fat has taken place to such a degree as greatly to congest the Malpighian bodies, and to interfere seriously with elimination.

Among the first, if not the first, to announce the important fact, that imperfect action of the kidneys may induce convulsions with fatal tendency, is Dr. Wilson, of St. George's Hospital, who communicated his views in a valuable paper read to this College in 1833. Dr. Bright and Dr. Addison have also contributed largely to our knowledge of this important subject. The latter distinguished physician has published a valuable practical paper on the affections of the brain which are associated with renal disease in an early volume of Guy's Hospital Reports.

I shall conclude by referring to another, and a very formidable form of convulsions, which, as occurring at a period when the patient stands much in need of mental composure, as well as of physical strength, often occasion serious consequences to her, and great embarrassment to the practitioner,—I allude to the form of convulsions commonly called puerperal.

These convulsions are truly epileptic : the paroxysm, excepting as regards the concomitant circumstances, is not to be distinguished from that of epilepsy. There are the insensibility, the foaming at the mouth, often the bitten tongue, the convulsive actions, and the torpor after the subsidence of the fit. These convulsions are sometimes accompanied by a maniacal state, either before or after the fit, as in ordinary epilepsy.

As far as I can collect from the records of the experience of others (for on this subject I must confess that I have no experience myself,) there seem to be three classes of cases in which convulsions form prominent symptoms.

The first class consists of women pregnant for the first time, previously in good health, or, at least, with whom no sign of deranged health has been detected ; or, in the words of a high obstetrical authority, Dr. Collins, "strong plethoric young women, with their first children, more especially in such as are of a coarse make, with short thick necks."

The second class consists of women, of greatly impaired health, who may have suffered recently from hæmorrhage.

And in the third class we may place women who suffer from disease of the kidney as manifested by an albuminous state of the urine.

A few cases likewise seem to result from the sudden development of apoplexy during parturition ; one or more vessels give way, and the convulsive paroxysm is induced by the laceration of the brain's substance, caused by the rush of blood into it.

And it must be borne in mind, that some of the patients may have been previously epileptic, and the occurrence of a fit near to, or during the period of parturition, may be merely a coincidence.

Such cases as these, therefore, and those of the apoplectic kind, ought not to be placed in the same category with *puerperal* convulsions.

My friend Dr. Murphy, Professor of Midwifery in University College, in some very valuable lectures lately published by him in the MEDICAL GAZETTE, makes a distinction between *sthenic* and *asthenic* convulsions, which is obviously most important in a practical point of view.

Puerperal convulsions occur before, during, or subsequent to parturition ; sometimes they will begin before labour commences, come again during labour, and finally recur after parturition. Of 200 cases collected by Dr. Murphy from various sources, forty-six occurred before labour, twenty-five after labour, and ninety during labour ; respecting the rest no precise information could be obtained. Enough, however, is known to indicate that the change in the system preparatory to and during labour has most to do with the convulsive paroxysm.

The statistics of these convulsions show that they must be considered, on the whole, as of a fatal tendency, for of 192 cases 48 died ; but it does not seem probable that in these cases the patient died solely from the convulsions. The results denote that the mode of delivery had something at least to do with the fatal issue of the case, as the deaths when turning took place were one in two ; whilst those when the labour was natural, were one in four and a half.

Of the post-mortem appearances nothing more is to be said than what I have already stated respecting the other convulsive diseases—namely, that the brain presents an essentially normal appearance. If the patient die in the struggle, the brain is much congested,—otherwise the amount of congestion is not excessive ; and, in some of the cases, the brain is in an anæmic condition.

Are the muscles or the nerves primarily affected in convulsive diseases ? Certain postulates respecting the Nervous system. Pathology of Chorea—proofs that the nervous system is primarily affected in it —the brain the seat of morbid action—influence of sleep—nature of the morbid process—a state of enfeebled and depraved nutrition. Chorea a humoral disease. Conclusions respecting its pathology. Treatment of Chorea. Pathology of Tetanic convulsive diseases—particular states of the blood favour the development of Tetanus. Pathology of Trismus nascentium and of Laryngismus. Dr. M. Hall's views. Treatment of Tetanus —use of cold, and of chloroform. Treatment of Trismus, and of Laryngismus.

HAVING in my first lecture briefly laid before you the prominent facts of the clinical history of the principal convulsive diseases with which we are familiar in this country. I shall now proceed to inquire whether, by the aid of physiology in conjunction with our knowledge of the clinical phenomena, we can form any reasonable view of the intimate nature of the pathology of these diseases.

It must be borne in mind that a disturbed state of the muscular system, although a prominent symptom of these maladies, and most commonly *the* prominent symptom, is nevertheless in many of them, accompanied with other sings which cannot be referred to the muscular system,—such as disturbed sensations, weakness of mind, delirium or mania, loss of consciousness, coma; but that in others, such as the tetanic convulsions, while the obvious phenomena are confined to the muscular system alone, the convulsions occur with a harmony and symmetry which denote, at least, that the common bond of union of the muscular system, that upon which depends the association of the movements of its various portions—namely, the nervous system—must be in some way or other involved in the disease. Why in Tetanus are the muscles of both sides of the body equally affected? Why in Laryngismus is the muscular convulsion limited in many instances to the laryngeal muscles extending in some to those of the neck and back? Why in epilepsy and chorea have you an affection not only limited to certain muscles, but exhibiting, as regards the character of the convulsion, essentially different features from each other, as well as from those of Tetanus?

It thus becomes a preliminary point in our investigation to determine whether in these various classes of disease the primary and essential seat of morbid action is in the muscular or in the nervous systems,—whether the morbid phenomena of the muscular system be dependent on certain disturbances of the nervous system,—or whether the muscular convulsions are primary, and the disturbed state of the nervous system consecutive and dependent on them,—or whether, in fine, the two systems are affected by one common cause, creating simultaneously disturbances in each, which predominate sometimes in one, sometimes in the other.

And let me here remark, that although we are much more accustomed to see the muscular system affected by changes originating in the nervous system, it is by no means unreasonable, nor inconsistent with fact, to affirm that changes originating in the muscular system may affect the nervous system.

Muscle and nerve generate each its proper force; and experiment teaches us that, while the nervous force ordinarily is the excitant of the muscular force, the latter, may excite the former in a similar way. This important point in physiology was first demonstrated by my distinguished friend Matteucci, of Pisa, whose researches on electro-physiology have placed him in the highest rank of natural philosophers.

Matteucci's experiments show that a muscle during its contraction evolves a force which acts upon a nerve brought into contact with it just as a galvanic current would do, causing the muscles which that nerve supplies to contract instantly. Now, if the muscles of a limb be thrown from some cause into powerful contraction, it is not unreasonable to suppose that the muscular force thus evolved may excite a corresponding evolution of nervous force, which in its turn may create a fresh evolution of muscular force, and thus by successive reactions, great disturbance of both the muscular and the nervous system may be kept up until both forces shall become weakened or exhausted.

In the present state of science we cannot fix on any cause not resident in the nervous system, which would excite extensively active movements of the muscular system *before* the nervous system, —such, for instance, as would occur in an epileptic convulsion. The only way in which such excitation of the muscular system could be produced, would be through the blood. Now a stimulus operating through the blood directly upon the muscles would be very unlikely to produce active contractions alternating with relaxations, such as occur in epileptic convulsions; on the contrary, it would give rise to permanent or tetanic contractions. The cramps with which the muscles of a limb are affected just prior to gout fixing itself in the joints, might be taken as an example of such a contraction induced in muscle by a morbid excitant conveyed to it by the blood; but even these, although often severe and extremely painful, are very partial. Yet I confess that this explanation of a phenomenon so simple as that of cramp is rather far-fetched; and this becomes at once apparent, when we reflect that a stimulus operating upon a nerve is a much more effective excitant than one operating directly upon a muscle. Take, for example, the best stimulus of muscular contractions, the galvanic force,—the contractions excited by passing a galvanic current through the twentieth part of an inch of the main nerve of a limb are much more powerful than those developed by the direct application of the galvanic power to the muscles themselves.

The argument, then, may be thus briefly stated: —We know by experiment that a cause operating upon a very small portion of the nervous system, may produce considerable muscular disturbance, not of one, but of several muscles; but that the same cause, acting on the muscular system directly, is much less effective, nor does such a stimulus excite *several* muscles by acting only upon one.

Is it not, then, going too far for the explanation of such a phenomenon as *muscular cramp*, to pass by the nerve, and to limit the influence of the cause to the muscle itself?

Is not this argument alone sufficient to direct us to search first in the nervous system for the immediate exciting cause of the muscular convulsions? Nor is there any reason why both systems should not be influenced by the same excitant, which, even though it were more especially accumulated upon the muscular system, would, in all probability, act primarily and most effectively on the nerves, and *through them* on the muscles, which, from their already excited state, would respond the more readily to this stimulus.

This is probably the case in poisoning by strychnine, one of those energetic substances which, if introduced into the blood in only a very minute quantity, seems to multiply itself*: thus to become diffused with extraordinary rapidity through the blood, affecting the two great tissues which are mainly concerned in the manifestation of the vital forces,—muscle and nerve.—but evincing a greater affinity for the latter than the former, and therefore acting with greatest energy upon it.

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* Or it is not unlikely that strychnine, prussic acid, and certain other substances remarkable for the *rapidity* as well as the energy of their action, may immediately on their introduction into the blood assume the gaseous form which is highly favourable to rapid diffusion.

I have felt it necessary to deal with this point thus early in our discussion of the pathology of convulsive diseases, in order that we might, by the elimination of a question which more or less encumbered the problem proposed, attend exclusively to inquiring into the nature and situation of the changes in the nervous system which give rise to the clinical phenomena of the convulsive diseases already referred to, of which the convulsed state of the muscles is only one.

I do not pretend to have exhausted this question, nor to have answered all the arguments stated with great perspicuity and ability by a distinguished Fellow of this College, Dr. J. A. Wilson, of St. George's Hospital. All that I have said goes only to show that the advocates of the muscular doctrine are so far unphilosophical in their mode of procedure, as they neglect the more simple and obvious explanation of the phenomena, and adopt a more complicated and obscure method.

In considering the share which the nervous system takes in the development of the clinical phenomena of convulsive affections, I must ask your assent to certain propositions respecting the mode of action of the nervous system in health, which the present state of knowledge warrants us in assuming to be proved.

1. That the nervous system, accumulated in masses, and spreading by its nerves throughout the body, mingling with the proximate elements of the various tissues, consists chiefly of a proximate element, of complex composition—namely, albumen, in combination with phosphorus and certain fatty substances, all well suited to the maintenance of constant and lively chemical action.

2. That this material is developed in two forms,—the vesicular or grey nervous matter, the fibrous or white,—and that the combination of these two different kinds of nervous matter, differing probably both in chemical composition, and in the form of their elementary parts, but more strikingly different in the one than in the other, takes place in the masses called nervous centres.

3. That at the points of junction or of intermingling of these two forms of nervous matter, blood is very freely supplied—very much more freely than where the fibrous matter exists alone. At these points there is generated constantly and unceasingly a force, which in its nature resembles very closely the galvanic force, or current electricity, as developed in the galvanic battery, or the magneto electric machine. Adopting the language of the illustrious Faraday, which expresses with clearness and precision the fundamental phenomena of the electric force, we may call the nervous power a polar force, generated in the centres, and propagated by the rapid polarisation of the neighbouring particles in various directions. The mode of generation of this force, the velocity with which it is transmitted to distant parts of the body, the beautiful provisions adopted for its insulation, have long attracted the notice of physiologists, and have led many to adopt the notion of its identity with electricity. But there are ample grounds for the opinion, that, although nearly allied to electricity, it differs from, and is probably a higher relation of force than that power.

4. The provision made for the generation of this force has an interesting relation to the conditions whereby the galvanic current is generated in the battery. Two dissimilar forms of nervous matter, both bedewed by the same blood, represent the zinc and copper, with the intervening electrolyte of the battery; and as the activity of the battery, and the energy of the galvanic force, depend on the amount of chemical action between the fluid, which is interposed between the metals and one of them, so the activity of the nutrient or chemical changes in the nervous centres determines the degree of development and vigour of the nervous force. And as in the galvanic battery we look to the nature of the metals as well as to that of the interposed fluid, to enable us to judge of the probable quantity and quality of the force generated; so, in the nervous battery, if I may so speak, we must look to the nature of the nervous matter of both kinds, and to the quantity and quality of the blood, to determine the amount and energy of the nervous force developed. Hence we may fairly assume that while the development of the nervous force is much influenced primarily by the nature of the nervous matter, it likewise is greatly dependent on the quantity, but more especially on the *quality* of the blood.

5. That the brain and spinal cord (and I beg to state that I use these terms to signify respectively the intra-cranial and intra-spinal nervous mass,) as the great centres of the nervous system —the great nervous battery of the body—show distinctly a division into two portions: one in which nerves are implanted; the other which has no immediate connection with nerves, and communicates with them only through the medium of the former part. Thus, in the brain, the hemispheres, the corpora striata, the optic thalamus, the tubercula quadrigemina, and the large mass of vesicular matter connected with them and the cerebellum, have no immediate connection with nerves—no nerve is implanted in any one of these centres. The functions of these centres are all of a mental nature,—either the development of intellectual change, or the exercise of volition, or perception, or emotion, or the balancing and co-ordinating of movements,—and they exercise a control over the various segments of that portion of the cerebro-spinal centre in which nerves are implanted through commissural fibres which pass from them to the various segments of that centre. That part of the cerebro-spinal axis in which nerves are implanted,—which was fully recognised by the distinguised Prochaska, and by him designated the *sensorium commune*—this part is in

itself incapable of originating any nervous action, except in virtue of some physical change in it: it cannot develope any mental action except in obedience to a stimulus from some of those centres already mentioned as belonging to the encephalon. This part extends from the upper part of the crura cerebri to the extremity of the spinal cord, and all its actions are physical, unless when excited and guided by any of the encephalic centres. It is the centre of all those reflex actions which take place through the spinal or encephalic nerves. This part corresponds to the true spinal cord of Dr. Marshall Hall, who, however, recognises in it two sets of fibres—one which does not pass beyond it, and another which extends from the various segments up into the brain, and which, according to this author, would establish a direct communication between the brain and the nerves. To this latter doctrine, however, there are many and fatal objections.

Having stated these postulates, I shall now proceed to inquire how the phenomena of several forms of convulsive diseases may be explained.

In the choreic affections it may well be inquired, first, whether the parts affected primarily are the nervous or the muscular system.

To this I answer at once, undoubtedly the nervous system; but I hope to show that in all these cases the muscular system participates in a depraved nutrition, which renders it more prone to sympathise with the irregular motions of the nervous system.

That the nervous system is primarily affected in chorea, appears to me clearly established, 1st, by the fact that the most common exciting cause of chorea is *fright*, or strong mental emotion. Thus in one of my cases, the patient, a girl of 19 years of age, was rudely accosted and laid hold of in the street by a person under the garb of a gentleman, and she became greatly alarmed, and escaped to the house of a relation. Next morning the symptoms of chorea showed themselves. Fright would act upon the nerves,—not upon the muscles. Grief also will induce chorea. A little girl in King's College Hospital, a veritable "Tilly Slowboy," experienced great grief at the loss of a child to whose care she was devoted. A few days afterwards chorea showed itself.

These mental causes do not act primarily upon the muscles, but upon the nervous centres and the nerves; and so frequently do mental causes give rise to chorea, that Rufz, in investigating 18 cases, traced the origin of 11 of them to fright.

2. In chorea, the nervous system is obviously peculiarly excitable. Choreic patients are much more agitated in the presence of others, than if left to themselves. Of this we have abundant exemplification in hospital practice. When the physician approaches the bed of a patient with chorea, accompanied by a crowd of students, the movements become greatly augmented, and continue so until the cause of excitement has been removed.

This view obtains further confirmation from the fact that we can explain the various phenomena of chorea much more distinctly by referring them to a primary morbid disturbance of the nervous system.

Admitting, then, that there is good ground for the belief that the nervous system is primarily affected in chorea, what portion of that system can we assign as the more special seat of the disturbed action? Is it in the spinal cord, or in the brain?—in that part in which the nerves are implanted, or in that which does not receive nerves?

All evidence tends to show that the part of the nervous system more especially affected in chorea is the *brain*. The hemiplegic character of partial chorea denotes that the disease is of cerebral origin; that the morbid process is most active somewhere above the decussation of the anterior pyramids. Were the spinal cord the seat of disease, you would find commonly that the disorder of movement affected both sides of the body.

Again, its frequent origin from a mental cause points to the brain as its seat. It seems in the highest degree probable that emotions of the mind affect that part of the brain which is most nearly connected with the points of implantation of the auditory and optic nerves—the channels though which emotional excitement is so frequently produced. This part was long ago pointed out by our celebrated Willis as being the corpora quadrigemina, and the large mass of nervous matter which constitutes the greatest part of the mesocephale, a centre which forms the common bond of union between the hemispheres of the brain above, the medulla oblongata below, and the cerebellum behind.

An affection of this part of the brain may, from its extensive connections, produce all the phenomena of chorea, either partial or general: partial, if the morbid action be on one side, as is so often the case in cerebral affections, when the muscular disturbance will be on the opposite side; general, when the affection is on both sides; and in the cases of extensive and acute chorea, the parts involved would not be limited to the centre of emotion, but would extend to the cerebellum, giving rise to the disturbance of the locomotive and co-ordinating powers; and, on the other hand, it would involve the corpora striata and optic thalami, and through them the hemispheres impairing voluntary power and sensibility, and contributing to that imbecility which frequently accompanies chorea of long duration.

The readiness with which sleep controls the choreic convulsions may be adduced as a further indication that this disease has its seat in the brain: sound sleep is undoubtedly a peculiar affection of the brain,—a state in which the particles of that organ seem to assume a condition of quiescence, which contracts remarkably with that unceasing, ever active change, of which it, more than any other part of the body, is the seat. This state, whatever it be, is incompatible with that which gives rise to the choreic convulsions; and hence the moment that sleep steals over the patient, and overwhelms his senses, the movements of the limbs, however active, cease, but return immediately the state of sleep has withdrawn.

I would remark here that this fact of the influence of sleep in controlling the movements of chorea, tells strongly not only against the view which localizes the morbid process of chorea in the spinal cord, but also against the doctrine which affirms the existence of a certain antagonism between the spinal cord and the brain. Were the spinal cord the seat of chorea, and did such an antagonism as I have referred to exist, the state of sleep would be the signal for the immediate development of increased and more active movements, and waking would rather tend to control these movements by the renewal of the activity of the brain.

And now we may inquire, what is the nature of the morbid process upon which the development of chorea depends?

With reference to this inquiry, we have the negative evidence of morbid anatomy that the morbid process in the brain is not such as to produce lesions recognisable by our means of observation; and we have the positive evidence of clinical observation that the disturbance which it produces easily admits of repair by natural means, or may be completely controlled by sleep.

If, with these facts, we consider the nature of the movements themselves, which are precisely those of an asthenic state, combined perhaps with some irritation, we get some further insight into the choreic morbid process. The movements are not unlike those which we observe under other circumstances of great debility, and when general nutrition is impaired,—the subsultus of typhus—the paralytic shaking of old age—the tremblings of the habitual drunkard. In all these cases the development of the nervous force is materially impaired—the material of the nervous battery is nearly exhausted—the exciting fluid is weakened; and hence you have a feeble nervous force irregularly developed.

And the general history of the patients who suffer from chorea abundantly confirms the view that the nutrition of the brain, and, indeed, of the whole nervous system, must be impaired. They are ill-nourished, weakly persons, often badly clad, with a poor and pale blood, more or less infected with the matter of scrofula, or of rheumatism, or perhaps with some morbid matter peculiar to chorea itself, or generated in the system by a depraved primary assimilation.

And, looking to the state of the muscles themselves, we cannot pronounce them to be in a healthy state. In choreic patients the whole muscular system is in a more or less soft and flabby condition; and, if you compress the affected muscles, you do not find the firm resistance of a muscle contracting with its normal vigour, but rather that which indicates that the muscle acts with feebleness, and is incapable of perfectly developing the muscular force.

But some one will ask, if the phenomena of chorea are in any way dependent on a depraved and poisoned state of blood, how comes it that they are so frequently localized? This localization of chorea to one side of the body, or even to one limb, or to the muscles of the tongue, is by no means inconsistent with what we know of the laws of action of morbid poisons. Witness the fixation of the syphilitic poison to the skin and periosteum,—of the scarlet fever poison to the tonsils and lymphatic glands—of measles to the lungs,—of cholera to the gastro-intestinal mucous membranes,—and look at the morbid localization of the matter of gout, as well as of that of rheumatism, even in cases where the blood is largely charged with it. It in no degree militates against the humoral view of the pathology of gout, that the morbid matter selects the great toe as its favourite locality; nor against a similar view of the pathology of rheumatism, that its morbid poison is prone to attack the heart.

I have now, I hope, said enough to justify me in drawing the following conclusions respecting the pathology of chorea:—

1. That chorea is a disease occurring at a time when the nutrition of the brain is passing as it were through a state of transition, from that of infancy or very early childhood, to that of the adult period, when that organ is peculiarly prone to suffer from mental shock, or other causes of disturbance of the system, and more especially when the blood is in an unhealthy state, deficient in some of its staminal principles, or containing some morbid element.

2. That the part of the brain mainly affected is the centre of emotion, but that the extent to which it suffers is sometimes limited to one side of that centre, sometimes to both, again extending to the cerebellum or to the corpora striata, or optic thalami.

3. That the nature of the cerebral affection is one of weakened nutrition, with some degree of irritation; as poor blood, rendered perhaps impure by the presence of the matter of scrofula, or of rheumatism, or by some morbid matter peculiar to chorea, excites the nervous battery, and causes it to generate its force feebly and irregularly. The centre of emotion thus feebly excited and irritated by the presence of an abnormal ingredient in the blood, extends its feeble and irregular polarity to that portion of the centre of implantation of the nerves, which, as the polar state of the conductors of the battery is regulated by that of the battery itself, exhibit the same enfeebled polarity as the centre in which they are implanted.

Lastly. The disease is essentially one of depraved general nutrition, which must be set right before the symptoms which arise out of the local disturbances can be removed; and this is the point of practical interest which must regulate our treatment of the disease.

These conclusions respecting the pathology of chorea receive confirmation from the facts to which I have already alluded—namely, that choreic movements occur in certain gouty states, and also in white softening of the brain, arising from diseased arteries. Under both these conditions the nutrition of the brain, as well as that of the nerves and muscles, must be depraved and weakened; depraved, especially in the former instance, by the matter or poison of gout; weakened in both.

And the treatment which is now by general concurrence, and with an unanimity which scarcely exists as regards the treatment of any other disease, pursued in cases of chorea goes further to confirm these views. No one now-a-days thinks of adopting for this malady any other treatment but one eliminatory and corrective of the various secretions, by the use of purgatives, and at the same time tonic and bracing to the nervous system, by the free application of cold water to the surface, and also tending to improve the quality of the blood, by a nourishing diet, by chalybeates, quinine, and various metallic tonics. And if, notwithstanding the use of these strengthening remedies, the nerves of the limbs still exhibit debility or paralysis, the application of the stimulus of galvanism rarely fails to excite and promote their nutrient activity.

This plan of the treatment of chorea has not been adopted with such general consent without the previous trial of other plans. Sydenham, as is well known, treated chorea by bleeding; but he appears to have had very little experience of the disease. The authority of Sydenham appears to have led his successors to continue this mode of treatment; and even Cullen had not wholly abandoned it,—so hard is it to give up a practice sanctioned by high names. Heberden, indeed, had arrived at a different conclusion. This eminently practical physician says—"Bleeding and purging, and violent medicines, can hardly be judged proper for a distemper attended with no inflammation nor heat, and particularly incident to a very tender age, and to the weaker sex; and which, if left entirely to itself, would, I believe, generally cease spontaneously, and leave the constitution unhurt. This reasoning, he adds, appears to me to have been justified by fact and experience. When they have been used, I never saw any good effects from them, and rather suspect that they have done mischief."

In the acute form of general chorea, it is very important that the practitioner should not suffer himself to be led by the urgency of the symptoms, and the violence of the movements, into the adoption of any depleting or depressing treatment under the notion of stopping the movements by reducing the powers of the patient. The more you weaken the patient under these circumstances, the more incessant and urgent will the movements become. Great diligence, however, is needed in administering support and stimulants with the utmost freedom, and in throwing in large quantities of quinine and iron, or other tonics, care having been previously taken to unload the bowels by clyster or by purgatives. Great benefit also arises from the free and frequent use of the cold bath; from what I have myself seen, I would say that the greatest immediate benefit arising from the use of the cold bath is from its exciting a disposition to sleep much more decidedly than opiates, which do not generally act favourably in any of the forms of chorea.

The next subject to which I shall beg your attention, is the Pathology of those convulsive affections, of which Tetanus is the type.

We have very satisfactory means of demonstrating that in tetanus the phenomena are dependent on a peculiar state of the nervous system, as it is so easy to produce all the phenomena by the application of stimulants to the spinal cord.

Thus by successive shocks from the magneto-electric machine, transmitted through the spinal cord, the state of tetanus may be produced, and it will remain for some time after the current has ceased to be transmitted. If similar shocks are passed through the chief nerve of a limb, a similar tetanic condition of the muscles immediately follows, but it *ceases instantly* the transmission of the current is discontinued.

So, also, the administration of a few grains of strychnia will produce tetanus; and in cold-blooded animals, as in the frog, opium will also develope tetanus, but in a less degree than strychnine.

The phenomena developed by the transmission of a rapid series of galvanic shocks through the spinal cord, are not to be produced by stimulating any other nervous centre in the same way. You may apply the galvanic power to any part of the brain, only keeping clear of the centre of implantation of the nerves, and you will fail to produce any tetanic phenomena whatever.

The most striking proofs may be obtained to show that the spinal cord is the seat of excitation in poisoning by strychnine. If you give an animal strychnine so as to produce tetanus, you may pith him, and yet the tetanic state will continue. Or in a cold-blooded animal (in which the nutrient actions, although more feeble, are more enduring,) if you pith the animal first, and then administer strychnine, the tetanic state will nevertheless come on, and last for a considerable time; but the moment you destroy or remove the spinal cord, that instant all rigidity of muscles disappears, and the stiffened limbs become immediately relaxed.

And it is very remarkable that while, by the introduction of a minute quantity of a particular alkaloid, or, in cold-blooded animals, of opium into the blood, you can produce the state of tetanus with great facility,—it is very difficult, if not impossible, to obtain tetanic symptoms by wounds inflicted for that purpose, even in the most highly sensitive parts; a fact of much interest in reference to the frequent endemic occurrence of Tetanus, and of other convulsive affections of a tetanic kind, and tending to show that a particular state of the blood is favourable to the development of Tetanus.

The symptoms of Tetanus as it affects man and some of the lower animals, the horse for example, so precisely resemble those of the disease as it is artificially produced, that it is impossible to resist the conclusion, that not only the part of the nervous system affected, but also the nature of the affection, must be the same in both (if I may use the distinction.) the artificial and the natural disease.

The part of the nervous system affected is clearly the spinal cord, and at least the greater part of its intracranial continuation, the medulla oblongata; and it seems highly probable that the anterior horns of the gray matter of the spinal cord and the centres of implantation of the encephalic nerves, are more particularly affected.

And the nature of the morbid process is not one of inflammation, nor does it arise out of any alteration in the *quantity* of blood flowing through the cord; it is not due to any congestive state, nor to any anæmic state, it consists of an exaltation in the special property of the nervous matter; an exaltation in the generating power of that portion of the great nervous battery in which the chief cerebro-spinal nerves are implanted; in short, it is a state of exalted polarity of that centre, produced either by the extension of a similar polar state, developed at the distal extremity of some nerve, or by some modification of the nutrition of the cord caused by the development in the blood of a material having similar properties to that of the alkaloid, strychnia.

Or, in the language of physics, the exalted polar state of the battery is due either to an altered condition of its generating and conducting plates, or to an increased activity of the fluid by which they are excited—perhaps, indeed, to both.

Such, then, is the pathology of Tetanus. A man receives a wound—this wound occasions an irritated, a polar state of certain nerves—and this polar condition is communicated by a process of induction to the whole spinal cord, which, by some modification of the nutrition of the cord due to some altered state of blood, assumes that state the more readily, and retains it the longer.

Unless we admit that the blood has some share in the production of the phenomena, we shall fail in explaining the occurrence of Tetanus without injury, or the tetanus of infants, but more especially we shall fail in explaining its greater proneness to be developed in certain localities, or in certain states of atmosphere and climate.

And surely the fact to which I have already adverted, of the much greater facility of inducing this polar state of the spinal cord by the introduction of certain substances into the blood even in almost infinitesimal quantity, than by mere mechanical irritation of the nerves, strongly points to and favours the conclusion, that a change in the natural condition of the blood may greatly promote, if not wholly cause, the development of the tetanic state; and this change in the blood may be caused either by the introduction into it of some new material from without, or by the generation within it of some new matter possessing highly poisonous qualities.

All that I have said respecting the clinical history of the Trismus nascentium, and of Laryngismus stridulus, shows that these diseases must be precisely similar to tetanus in the essential points of their pathology.

The Trismus, indeed, is only a very acute form of Tetanus, and its endemic character, and its proneness to occur under circumstances unfavourable to free ventilation, and good general nutrition, are highly confirmatory of the view I have ventured to advocate of the probable influence of a morbid state of blood in promoting the polar state of the spinal cord and medulla oblongata.

Laryngismus differs from Tetanus in the fact that the polar state of the nervous centre is less permanent, and that the medulla oblongata is more affected than the spinal cord. In Tetanus, the spinal cord is more affected than the medulla oblongata. The proximity of the medulla oblongata to the centre of emotions, explains the extreme excitability of children suffering from Laryngismus by mental emotions.

In Laryngismus, there is nothing whatever of an inflammatory nature, nor is there anything of a congestive kind: it is most important that practitioners should be well impressed with this fact.

Whatever congestion may arise in the nervous centres is venous, and is caused by the convulsive paroxysms, which impede respiration, and consequently delay the return of the venous blood. It is, then, an effect and not a cause of the convulsive state.

We have in laryngismus only an exalted polarity of the nervous centres, caused either by peripheral irritation, as that of dentition, or by a morbid blood produced by imperfect feeding, artificial nursing, bad air, neglect of cleanliness, or associated with a highly scrofulous diathesis.

These views of the peculiar condition of the spinal cord in Tetanus and the allied affections were, so far as I know, first put forward by Dr. Marshall Hall, to whom science is under great obligation for the introduction of sounder views on many points in the application of physiology to pathology. That distinguished physiologist, with whom I regret to find myself at variance on many points, in an interesting and valuable essay on convulsive affections, makes these remarks:—"Tetanus and Hydrophobia consist in an induced spinal erethismus, the paroxysms consisting of augmented or excited spasm, from external excitants. The infant, under the influence of what I will designate the convulsive tendency, susceptibility, or erethismus, may therefore be compared to the patient attacked by tetanus. The causes are similar—irritated nerve, inducing spinal erethismus, and great susceptibility to excited reflex actions; the effects are analogous—tetanoid affections."

Hitherto the various plans of treatment pursued in Tetanus have received but a small amount of success. I am inclined to attribute their failure partly to the fact that practitioners have not sufficiently kept in view the important point, that death takes place, not by any disorganization of important vital organs, nor by the destruction of processes essential to life, but by the exhaustion consequent on the frequent renewal of the paroxysms of tetanic convulsion,—and partly, also, to this fact, that our treatment has been hitherto so empirical, that no definite plan seems ever carried out with sufficient fixedness of purpose in a sufficiently large number of cases.

The pathology and clinical history of Tetanus point out three objects which the practitioner ought constantly to keep in view in the treatment of it.

1. To support the strength of the patient as much as possible, so as to oppose the exhausting effect of the convulsive paroxysms.

2. To remove all possible sources of irritation or of depravation of the blood, in vitiated secretions, bad diet, impure air.

3. To diminish and reduce the exalted polarity of the nervous centres to their normal condition, and if possible to effect this by means which will not exhaust or reduce the powers of the patient.

Now, the first indication is of primary importance: if the patient can be duly supported, we gain time, and we have abundant proof that the natural powers of the system are often capable of doing the rest without any assistance from art.

To accomplish this object, the practitioner should set himself diligently to devise means of giving nutriment and stimulants in the manner in which they may be most readily assimilated. As a general rule, this may be done best by giving them frequently, and in small quantities; and it is wonderful how much may be taken in this way if they are only administered with care and judgment.

Any process of depletion—by loss of blood, or by evacuants of any kind, carried to a great extent, would be highly objectionable, as being calculated to oppose the object in view.

In addition, then, to the various articles of food best adapted to the assimilating powers of the patient, and also to wine, or other alcoholic stimulants, the practitioner ought not to withhold the liberal use of quinine, ammonia, iron, or other drugs, which experience tells us exercise a tonic power over the system in general,—and he may give them in large doses.

The second point may be best attained by means calculated to promote the various natural secretions, especially those of the bowels, skin, and kidneys. But in administering remedies for these objects, care should be taken not to use those of a violent and irritating nature: drastic purgatives should be avoided; too profuse sweating or diuresis should be guarded against; and the practitioner should bear in mind that the object is to alter and improve, not to pull down.

To obtain the third object—namely, to reduce the polarity of the spinal cord, is at once the most important and most difficult. The various sedative remedies—opium, hydrocyanic acid, belladonna, conium, tobacco—have been fairly tried and failed. Opium is not a sedative to the spinal cord; its use in tetanus may be laid aside excepting in small doses as a sudorific. In cold-blooded animals it exalts the power of the spinal cord, and it is not impossible that in warm-blooded animals it may have a similar tendency: it is, therefore, a remedy of little value in tetanus, save as a sudorific, and in large doses it may be of an injurious tendency.

Neither is hydrocyanic acid a sedative to the spinal cord; on the contrary, it tends to produce epilepsy, and to excite the polar state of the cord by induction from the brain.

Belladonna has a decidedly sedative influence, but it disturbs the action of the brain so much, that it is not a safe or manageable remedy. The same may be said of conium. Tobacco undoubtedly reduces the polar state of the cord, but it produces at the same time a state of fearful depression. It is likewise an unsafe and not a manageable remedy. I have seen more than one patient die, *cured* of Tetanus, under this remedy.

There are two agents which certainly exert a considerable power over the polarity of the spinal cord, which have not yet been tried sufficiently fairly, and which I think fully deserve to be put extensively to the test of experience. These are—cold and chloroform.

Of cold I can speak favourably from my own experience: I have tried it by the application of ice in ox gullets to the spine, taking care to renew them frequently. I have adopted this practice in Tetanus, and in convulsions in which the spinal cord was much involved, and in other more partial states of exalted polarity of the spinal cord, and with a sufficient amount of success to justify me in forming a very favourable opinion of the powers of cold as a depolarizing agent.

In order to give the remedy a fair trial, great vigilence is required on the part of the attendants of the patient to renew the bladders very frequently, otherwise they become elevated to the temperature of the body. This should never be permitted, as it is only by the long-continued application of cold that the spinal cord can be reached by it.

Another point which the practitioner who uses cold in this way must keep in view is, that when the cold fairly reaches the cord, its influence is shown by a marked depression of the action of the heart, which leads to general depression and debility. During the application of the bladders in this way, increased vigilance will be necessary in the administration frequently, and at short intervals, of nutritious and stimulant substances.

Sometimes the depression of the heart's action reaches a point below which it would be unsafe to suffer it to go. Under these circumstances the ice must be removed, and kept off until the heart in some degree recovers itself, when it may be resumed. Thus by removing and reapplying the bladders from time to time, the influence of the cold may be kept up sufficiently long to produce a favourable effect upon the cord without producing such an amount of depression as may operate to the disadvantage of the patient. But to carry out this plan great vigilance, and care, and judgment, will be needed on the part of the practitioner, in order that all precautions may be duly observed, and that the patient may be encouraged to persevere in the use of a remedy which involves some degree of personal discomfort.

Of chloroform, tetanus or tetanoid affections, I have no experience. Two years ago, however

I performed some experiments, by which I satisfied myself that the analogous agent, ether, when introduced into the system by inhalation, exercised a most powerful controlling influence over the polar state of the cord, as induced by strychnine.

In these experiments I found that previous etherization retarded the polarising influence of the strychnine; and that, after poisoning by strychnine, life might be prolonged for a considerable time by the administration of ether.

A guinea-pig was thrown into tetanus by a quarter of a grain of strychnine: immediately the tetanic symptoms showed themselves, he was etherized; the state of tetanus immediately passed off; in a short time, however, it recurred, and was again controlled by ether: and by thus repeatedly etherizing the animal when the tetanic symptoms reappeared, life was prolonged for many hours, whereas another animal of the same size, and poisoned at the same time by the same dose but not etherized, died rapidly.

These experiments illustrated in a very striking manner the antagonistic power which ether (and chloroform, as possessing identical virtues) can exert over the polarity of the cord. The great point which ought to engage the attention of practitioners in the application of these agents to the treatment of such cases as Tetanus, is to know how to avail themselves of its depolarizing power, and at the same time to guard against the injurious effects of its depressing influence. Chloroform weakens the force of the heart,—sometimes diminishing, at other times increasing the frequency of its action. Hence, while administering it in tetauus, we shall find it necessary to use with increased diligence the means calculated to uphold our patient's strength; and we must take care that the sleep of chloroform does not prove to him the sleep of death, by depriving him too long of those supplies which alone can counteract the destructive asthenia.

In the absence of any experience of the use of chloroform in tetanus, I should advise that a patient be not kept under its influence for any length of time, and that if, after the administration of it, and after its more profound effects have passed away, he should continue to sleep, the sleep should be interrupted at intervals of an hour or of half an hour, according to his strength, in order to administer support. If the patient does not sleep after the administration of the chloroform, and if the effects pass off, then it should be administered a second time, and a third time; after which several hours should elapse before it is again administered, and then it should be given in a similar manner, taking care that it be given not more frequently than at three, or, at most, four different periods in twenty-four hours.

These suggestions, however, are prior to experience: they want the support or the modification which observation only can give, and I should not venture to offer them were it not that it seems to me of great importance that we should not discard an agent so powerful as chloroform, against certain morbid states, without giving it fair play, sifting its merits and demerits, and employing it in various ways, so as, if possible, to secure the benefit of the former, and to guard against the disadvantages of the latter. In some of the cases of tetanus in which I have heard of chloroform being employed, it has seemed to me that the patient was kept too long under it at once,—that its renewal was at too short intervals,—and that sufficient precautions were not taken to counteract its depressing influence.

We have yet much to learn respecting the application of so powerful an agent as chloroform to the relief of nervous affections. But I dare say the time is not far distant when we shall be able to form a more exact judgment of its powers and applicability to these diseases. To those who are interested in this subject, I recommend the perusal of some interesting essays now in course of publication in the MEDICAL GAZETTE, by Dr. Snow.

The rapid course which trismus nascentium generally runs, and the feebleness of the little subjects of it, do not permit us to expect that we shall ever be more successful in the treatment of that fearfully acute tetanus than our predecessors. What we may really hope for is, that as careful attention to cleanliness and ventilation, and the early good management of the infant, has greatly diminished the number of cases of the disease,—so improvements in these respects may yet blot it out entirely from the list of ills to which the newborn infant is exposed.

The views of the pathology of the disease which I have endeavoured to advocate, suggest that the most promising mode of treatment is that by very frequent copious affusion of cold water, especially over the back and along the spine; such precautions being taken as may ensure the speedy restoration of the animal heat, and prevent its undue depression: such as good friction of the skin, quickly enveloping the infant in warm blankets after each affusion, maintaining a uniform temperature of the apartment, which, however, should at the same time be most carefully ventilated. To these should be added good feeding, and such attention to the state of the bowels as will secure the discharge of their contents without any active purging, which might prove an additional cause of exhaustion. Change of air would be most desirable, when it would be possible. But these cases run a course so rapid that it rarely happens that there is time for the adoption of such means.

Judging from the reports of cases as they are from time to time published in the medical journals, I would say that the views of practitioners are becoming pretty well agreed as to the most effective treatment of laryngismus stridulus. The points which should especially engage our attention, are—first, as to the best means of removing all sources of irritation; secondly, as to the most appropriate mode of promoting a healthy and vigorous nutrition; thirdly, the proper measures to adopt for diminishing that extreme excitability of the nervous system which keeps up the frequent repetition of the convulsive paroxysm.

It is very important that all sources of irritation should be removed as early as possible. What we most frequently find to excite irritation, are—accumulations or morbid secretions in the bowels, and the inflamed gums in dentition. The first may be easily removed by the action of purgatives, so regulated as not to impair the strength of the patient, nor themselves to act as irritants. Inflamed gums are likewise easily relieved by free incision with the gum lancet, which it may be necessary to repeat once or twice. But I must remark that the gum lancet must not be used indiscriminately; to many children the mere attempt to open their mouths occasions great disturbance, —nay, a greater disturbance than the inflamed gums which it is sought to relieve,—and it may excite a paroxysm which may prove fatal. Hence I hold that this operation ought not to be performed unless it be rendered absolutely necessary by *a really inflamed and swollen state of gums.* Under such circumstances, the relief to be obtained by the free division of inflamed mucous membrane is frequently so immediate and so great, that we may legitimately encounter the risk which the operation occasions, in order to obtain so great a benefit. But where there is no inflammation of the gums, where it is plain that the teeth are not impeded in their advance by inflamed mucous membrane, no good can be obtained by the incisions.

Still more objectionable must be the practice of frequent or daily division of the gums; by such a procedure you expose the child to a daily repetition of a scene of great excitement, without any corresponding benefit. For what can be gained by such a practice? The teeth are not delayed in piercing the gums in consequence of any mechanical obstacle; their tardy progress is the result of a slow and inactive nutrition: in short, they grow slowly, and therefore are slow in cutting their way through the gum. Is it to be expected that the frequent repetition of the operation of cutting through the gums will hasten the growth of the young teeth? I think not: on the contrary, there appear to me to be some strong grounds for the apprehension that such operations may retard the growth, and injure the nutrition of the young teeth.

There are many cases, however, in which dental irritation does not exist; that is, in which there are no teeth exciting painful inflammation of the gums. In such cases there will not be any need for surgical interference with the mouth. But in these and in all cases the practitioner will have to apply himself diligently to devise the best mode of promoting a healthy and vigorous nutrition. And for this purpose he must attend to the quality of the food, its quantity, the manner in which it is given, the periods of feeding; on one or all of these points he will certainly find something to alter and amend. Either he will find that an infant is being brought up by hand when it ought to be nursed, or it is nursed too often, or with milk of bad quality, or it is fed in some imperfect manner.

Time would fail me, were I to enter upon the large and important subject of the best method of feeding infants. I must content myself with briefly referring to certain precautions which ought always to be taken, in order to insure to the child the full benefit of its food. First, it should be fed *slowly*: this rule, so important in the adult, is not less so in the infant; and the question, in cases where the infant is not nursed, between feeding with the bottle, by suction, or with the spoon, entirely turns upon this—whether, by the one or the other method, it is fed sufficiently slowly. The former mode is the preferable, as coming nearest to the mode of prehension most natural to the infant—that, namely, by suction; it is *objectionable*, as affording to careless nurses too easy opportunity of rapidly feeding the child.

A second point of importance is, that the child should not fast too long, and that too much food should not be given at each meal. Frequent meals carefully adjusted in quantity are undoubtedly best suited to the infantile economy, which is the seat of rapid growth, and therefore needs frequent supplies. Attention to the *rate* at which the food is administered will help in adjusting the quantity: a child fed slowly will take less food than one hastily and rapidly fed.

Lastly, the quality of the food should be determined mainly by the period of infancy, but also by the power of digestion evinced by each individual. Speaking generally, in the earliest periods the food should be simple and uniform: if the infant cannot be nursed by its mother or by a healthy wet-nurse, its food should be as nearly as possible assimilated to human milk. As the infant advances life, farinaceous matters obtained from the flour of wheat, as containing gluten, should be gradually and cautiously added; and after the fourth or fifth month, gelatinous and albuminous matters derived from animal food may be given in small quantities.

But whilst the practitioner is carrying out these reforms in diet, he must not forget that he is urgently called on to diminish the frequency of the paroxysms. For this purpose he must cut off as much as possible all external causes or means of excitement, and he must adopt measures to diminish the excitability of the nervous system.

Let me here remark, that there are few occasions in which the practitioner stands more in need of that support which is so fully derived from confidence in himself and in his principles, than in the treatment of such a malady as laryngismus. The anxiety of parents, always great when a child is in danger, is wound up to its highest pitch when it is afflicted with a malady which threatens every moment to deprive him of life. They therefore naturally look most eagerly for the speedy adoption of the means which will mitigate the severity of the paroxysms, and diminish their frequency. Under these circumstances the practitioner must let it be seen that, while he is fully alive to the imminent danger in which his little patient is placed, he has a sufficient command of resources, and he is guided by certain principles of action, which he will carry out with decision and vigilance.

The plan of dashing cold water in the face, to avert an impending paroxysm, or to shorten an existing one, is generally attended with success, as regards the paroxysm. It is also, I think, useful in shortening the intervals between them, by diminishing the excitability of the cutaneous nerves. This dashing with cold water should be administered liberally and rapidly, notwithstanding the concomitant inconvenience of wetting the child's clothes. In some instances the operation of drying the child and putting on fresh clothes is itself useful. On similar principles, I find it very useful to have the child well sluiced with cold water night and morning, and sometimes even a third time in the day. A large quantity of cold water should be dashed *rapidly* upon the back and shoulders, and along the spine,—a moderate pitcher of water being *at once* emptied upon them. The value of the remedy is greatly enhanced by the suddenness of its application. In this suddenness consists the skill of its administration; and unless this be well done, it had better not be used. For this reason it is expedient that the practitioner should at first superintend its administration himself, and teach the nurse how to apply it.

The cold effusion not only diminishes the excitability of the cutaneous nerves; it likewise improves general vigour, stimulates the circulation of the skin, and consequently increases the action of that great emunctory, and contributes to promote a more healthy state of general nutrition.

If drugs are used, the most valuable (in addition to such purgatives as may be necessary to keep up a moderate action of the bowels) will be found to be those of the tonic and antispasmodic class. I have myself seen most advantage from the use of iron in combination with alkalies, potash, or ammonia. Assafœtida is extolled by some. Sir. H. Marsh commends the old Tinctura fuliginis. The infusion of bark, the liquor cinchonæ of Battley, the tincture of bark, quinine itself (the chief objection to which is its intense bitterness of taste,) will all prove more or less useful.

Depletion by bloodletting, whether general or local, may, I think, be completely discarded from the list of appliances, at the command of the practitioner in the treatment of this malady. In most instances it may do great harm by impoverishing the blood, and increasing the excitability of the nerves, and weakening the patient. I have not met any cases in which it has appeared to be advisable, unless as a means of satisfying the prejudices of parents or others. The disease is clearly not inflammatory; all who have seen it on a large scale agree in this view: and whatever congestion may arise in the nervous centres is the result of the paroxysm, and not their cause. Some may think it advisable to use depletion for the relief of this congestion. Upon this point it is obviously impossible to lay down any general rule. In my own experience I have not met with any instance of congestion of this kind which has not been sufficiently easily relieved by purgatives and attention to diet.

Of all the remedies which are adapted to increase the tone and vigour of the nervous system, none is so potent as the exposure of the child to fresh air, especially to that of a locality different from that in which it had been accustomed to live. There are few who cannot bear testimony to the efficacy of this practice. In principle it should be carried out throughout the whole treatment of the case. The child should be kept if possible in an airy, well-ventilated apartment, of moderate temperature. Everything like what is commonly called "coddling" should be avoided. The child should be lightly *but sufficiently* clad, and be kept free from all such articles of clothing as might in any way impede the superficial venous circulation, or interfere with the free action of the respiratory muscles. If complete change of air cannot be obtained, it is a good plan to take the child out daily in a carriage into the country, to some distance from its usual residence, where, if the weather be not too cold, it may be carried about in the open air.

Many practitioners have a fear of adopting the change of air system, lest the patient should incur the risk of bronchitis. This fear is, within certain limits, well founded. But I think it right to mention here, what I have not seen referred to elsewhere, namely, that one of these patients may have the physical signs of bronchitis without the disease. A spasmodic state of the bronchial muscles frequently coexists with the spasm of the glottis, often precedes it, and remains for a considerable time after it. This is accompanied by a generally diffused *ronchus*, such as would occur in bronchitis. It subsides immediately the general state of spasm subsides. Of these points I have had frequent opportunity of satisfying myself.

Children often fall into what I would call a *laryngismoid* state, *i. e.* a condition in which the tendency to laryngismus is manifest, with great nervous excitability. If the child cough, inspiration is attended with a croupy noise. Crying, or any forced respiratory act, exhibits similar phenomena. But no regular convulsive paroxysm occurs. In these cases great benefit is derived from daily exposure to the air, and from a treatment conducted upon the same plan as for the fully developed malady.

Such, then, are the principles and the plan of treatment of laryngismus. It is but just that I should mention that these views of the pathology and of the treatment of this disease have long been *practically* recognised by men of experience. The late Dr. Cheyne has left a brief but clear description of the disease, published thirty years ago; and I know no more accurate and clear account of the disease than that given by my friend Sir Henry Marsh, in the Dublin Hospital Reports, in 1830, where principles of treatment similar to those I have endeavoured to lay down, are inculcated. Dr. Marshall Hall has also ably illustrated the pathology of the disease, and given some judicious instructions for treating it. Some valuable practical remarks on the treatment of the disease were published by Dr. Roberton, of Manchester. And, lastly, a very able essay upon it has lately been published by Dr. James Reid, of this city, which is interspersed with excellent observations, both pathological and practical.

THEORY OF EPILEPSY.—*Phenomena essential to epilepsy—Epileptiform convulsions dependent on superficial disease of the brain—Case—Points to be explained by an adequate theory of epilepsy—Epilepsy not due to primary irritation of the spinal cord—What part or parts of the brain affected in epilepsy. Not the Medulla oblongata, nor the Corpora Striata and Optic Thalami—Affection of the hemispheric lobes explains the loss of consciousness—Can superficial irritation of these parts of the brain cause convulsions? Periodical action of the brain—Sleep—Dr. M. Hall's theory of sleep—Objections to it—The mesocephale affected in epilepsy—Experiments by the magneto-electric machine on different parts of the cerebro-spinal centre—Clonic convulsions caused by irritation of the meso-cephale—Conclusion as to the parts of the brain concerned in the production of epilepsy—Inquiry into the nature of the cerebral disturbance in epilepsy—Is it inflammation? Congestion? Anæmia? Theory of the disease—Humoral view—Treatment by drugs—by discipline and regimen—Use of chloroform in epilepsy.*

To frame an adequate theory of the pathology of epilepsy, is, I feel, a task of no ordinary difficulty. Although much has been done of late years towards forming exact views of the functions of the several parts of the great cerebro-spinal axis, we are still very uncertain as to the precise influence which each part has on the others,—as well above as below it,—and how far a disturbance of any one may involve the rest in a like disturbance. While such obscurity exists respecting the office of important parts of the nervous system, it is impossible not to approach the subject of the pathology of epilepsy without a feeling of hesitation and mistrust.

The leading and pathognomonic features of true epilepsy are these:—loss of consciousness and sensibility, most frequently accompanied by convulsions of the kind which I have described as epileptic, *i. e.* of movements which consist of alternate relaxations and contractions of muscles rapidly succeeding each other; these paroxysms occurring at intervals of variable length, with something of periodicity, the patient during the interval recovering himself completely. These phenomena are most frequently ushered in without any warning whatever, so that the patient is suddenly, and on the instant, seized, rendered senseless, more or less violently convulsed, and then awakes more or less suddenly. In many instances all this is done in scarcely as much time as it takes to describe the phenomena; at other times the fit is of much longer duration.

Now it must be carefully kept in view that the complete epileptic paroxysm is compounded of many phenomena, of which the primary and constant ones are the loss of consciousness, and the disturbances of sensibility which usher in the fit, or remain after it. We never meet with instances of epileptic convulsions affecting the whole system, and recurring periodically, which are not ushered in with loss of consciousness, or accompanied by it. We do, however, frequently meet with instances of the sudden loss of consciousness, lasting for a longer or shorter time, without any muscular disturbance; and this loss of consciousness is accompanied by a peculiar vacant look,—an aspect entirely devoid of all indication of intelligence,—expressive, indeed, only of the temporary abeyance of the intellectual power, and attended with a dilated condition of the pupils;—a feature of the epileptic state quite as constant, perhaps, as the loss of sensibility and consciousness, and which is very apt to remain, although in a less degree, after the fit, and throughout the entire period intervening between the fits.

There are, however, certain epileptiform disturbances of motion not accompanied by loss of sensibility, which it may be as well that I should notice here, partly to draw the line of distinction between them and the true epileptic convulsions, and partly because a right appreciation of the nature and character of these pseudo-epileptic movements will assist me in the course of this discussion. These movements occur in paroxysms: they consist of alternate rapid contractions and relaxations, with, however, a great tendency to muscular cramp or rigidity. If, for instance, the arm is affected, the movements will consist of rapid flexions, alternating with extensions, but in the intervals the muscles will feel firm, and more or less rigid. Sometimes, however, the reverse takes place, and a state of paralysis ensues upon a violent convulsive paroxysm. In such cases the convulsion is never general,—always partial, and confined to one side, one arm or one leg, or both, with the side of the face. In many instances the movements are no more than twitchings, and in all, the experienced eye would readily detect the difference between their half tonic, half clonic nature, and the forcible plunging truly clonic character of the proper epileptic convulsion.

Such movements as these accompany superficial irritation of the hemispheres of the brain or of the cerebellum. I have seen them most frequently in children, associated with the so-called tubercular meningitis; or, more properly, meningitis and encephalitis, excited by the presence of tubercles in the pia mater.

A case of this kind came under my observation some years ago, which afforded a striking instance of these pseudo-epileptic movements, as I would call them. As the case has been made public by Mr. Dunn, the surgeon under whose care the child was, and who kindly afforded me the opportunity of seeing him, I shall refer to his clear and able account of it published in the Medico-Chirurgical Transactions for details, and content myself with mentioning those points which are most applicable to my present purpose.

The boy was two years old, and of strumous habit. He had for some time been failing in health, and shown excessive perverseness of temper. On the 7th of October he awoke, as he was accustomed, between six and seven o'clock in the morning, and while amusing himself with his sister in bed, and attempting to turn over, his left hand suddenly began to take on a jerking or convulsive twitch, which did not extend beyond the wrist. Mr. Dunn saw the patient immediately, and found that these convulsive jerkings formed the only symptom exhibited by the child. He was laughing and talking, quite sensible, and in every other respect seemed perfectly well. These jerkings continued for about twenty minutes, when they subsided, and the child was free from them the whole day. The next morning, the 8th, at nine o'clock, the convulsive movements returned, and continued for half an hour. The day after this the jerkings returned again at seven o'clock in the morning, but were much slighter than before. On the 11th, the convulsive movements returned again, and were not confined to the upper extremity, but involved the leg as well, the face also, and the angle of the mouth. On the 12th and 13th, the child had two fits in the day, affecting the whole of the left side: he cried and screamed towards the termination of the fits, but he was sensible throughout them. Each fit was followed by profound sleep.

Early in the morning, the 14th, Mr. Dunn was called up in consequence of a very severe paroxysm, which lasted three hours: the convulsive movements, affecting the left side from head to foot, were very severe: at times he screamed, at others he was quiet, and *throughout knew all about him*.

Under the increased frequency and severity of these attacks, and an extension of them, though in a slight degree, to the right side, with other symptoms of irritation of the brain, the patient died, and, on examination, it was ascertained that there existed an extensive deposit of tubercular matter on the surface of the right hemisphere of the brain, the opposite to the side on which the convulsions took place, and that a slight and recent deposit had taken place on the surface of the left hemisphere, and that the cerebral substance around the tubercles was in a state of red softening, interspered with inflammatory products, in considerable quantity. The tubercular deposits exciting inflammation of that portion of the brain which was in their immediate vicinity, no doubt gave rise to the convulsive movements on the left side, as well as to those which had began to show themselves on the right side of the body.

I would lay it down, then, that epileptiform convulsions without loss of consciousness are essentially distinct from true epilepsy, and may be developed by even a slight morbid irritation of the brain.

You will see that what we have got to explain by any theory of the pathology of epilepsy, is—

1st. The sudden occurrence of complete loss of consciousness.

2nd. The sudden privation of voluntary and locomotive power, with more or less violent epileptiform convulsions.

3rd. And all this occurring *at certain periods*, with more or less uniform and regular intervals, during which the patient may, and frequently does, return to a condition perfectly normal.

Lastly, our theory must explain why it is that these fits are so often accompanied with a maniacal state, and how it happens that their frequent repetition tends to destroy the power of the brain as the organ of the mind; and, moreover, greatly to impair the whole nervous force.

It seems needless to occupy time with discussing whether, during these formidable paroxysms of epilepsy, or, as it used to be called, of "falling sickness," the muscles or the nerves are primarily affected. All the obvious phenomena point to the nervous system as being chiefly engaged, and to the muscular convulsion as entirely consecutive to, and dependent on, the disturbed state of the nervous system. I would remark, however, that the enormous development of muscular force which must be produced during the convulsive paroxysm, must, in conformity with the discoveries of Matteucci, alluded to in my last lecture, have a most powerful reaction upon the nervous system.

The first point, then, which should occupy our attention must be as to the part of the nervous centres which is mainly disturbed in this disease—whether the spinal cord or the encephalon; and, if the latter, whether the whole or part of it: for it cannot be admitted that the disease is one of the nerves only: the nerves, indeed, may convey irritation to the centre, and again reflect that irritation to the muscles; but it would be impossible for such an amount of irritation as would create the paroxysm of epilepsy to exist without giving rise to great disturbance of the centres.

I think it cannot admit of doubt that in epilepsy the spinal cord is by no means primarily affected. That it is to a certain extent disturbed during the complete paroxysm which is accompanied by muscular convulsions, is evident; for otherwise the exciting cause of the convulsions could not reach the muscles of the limbs: but then this disturbance is secondary.

The nature of the convulsions shows that the spinal cord is not primarily affected. In my former lectures I have shown that the character of the convulsion dependent on primary irritation of the spinal cord is *tetanic*, with more or less permanent rigidity of the muscles and opisthotonos; and this can be clearly demonstrated by experiment. But although the convulsions of epilepsy are often complicated with a good deal of tetanic spasm, they nevertheless always present features which distinguish them, in a very marked way, from the tetanic convulsions, by the alternate contraction and relaxation,—violent combined movements, resembling voluntary acts, succeeded by relaxations, to be again succeeded by violent contractions.

Furthermore, if the spinal cord were affected primarily, we could not explain the sequence of the phenomena in the complete paroxysm of epilepsy.

If the spinal cord were primarily disturbed in epilepsy, the sequence of the phenomena would be—first, muscular disturbance, in consequence of the state of disturbance of the cord; then impairment of consciousness, in consequence of the extension of the disturbed state of the cord to the brain.

Now the natural sequence of the phenomena is —first, loss of consciousness; secondly, muscular convulsions.

Moreover, the supposition of the primary existence of disturbance of the spinal cord leaves us altogether without the means of explaining the phenomena of that form of epilepsy which in its consequences to the patient is quite as formidable as that accompanied by convulsions. I mean that form which consists simply in loss of consciousness, which lasts for a variable term, and then the patient recovers himself.

Lesions of the spinal cord, it is now well known, do not affect consciousness. You may have nearly the entire cord severed from the brain, and yet consciousness will be retained. A man falls from a height, and fractures his cervical vertebræ, smashing a considerable portion of the cervical region of the spinal cord: he is taken up paralysed, in both sensation and motion, at all points below the head, but *consciousness is undisturbed.*

In the convulsive diseases confessedly spinal in their origin,—namely, in tetanus and laryngismus, —consciousness is undisturbed, or but slightly affected, however violent the convulsions may be.

It seems, therefore, certain, not only that a highly disturbed state of the spinal cord will not impair consciousness, but also that that state of disturbance of the cord is not prone to extend itself to the brain, and to interrupt the functions of that organ.

And these arguments applied to the ordinary spinal cord of anatomists—the intraspinal nervous mass—are equally opposed to the location of the disease in the true spinal cord of Marshall Hall, or in the sensorium commune of Prochaska. The sensorium commune of Prochaska is the spinal cord *plus* its intra-cranial continuation as high up as the crura cerebri. But primary irritation of this latter part produces the same phenomena as that of the spinal cord, with the addition of more or less laryngismus: therefore it is not the part first affected in the epileptic fit.

It is plain, then, that the primary disturbance in the epileptic paroxysm must be located in some part of the brain.

Now this organ is divisible into certain parts, each of which, there can be no doubt, enjoys a separate proper function, notwithstanding that all the parts are intimately united to each other.

These parts are—

First. The hemispheric lobes, consisting of the convolutions and the large mass of fibrous matter connected with them.

Second. The corpora striata and the optic thalami, in intimate connection with

Third. The medulla oblongata.

Fourth. The corpora quadrigemina, in intimate connection with, and part and parcel of the mesocephale.

Fifth. The cerebellum.

Pursuing the method of exclusion, I hope to arrive at the determination of the part the disturbance of which gives rise to the phenomena of epilepsy, and of the epileptic paroxysm.

I shall first eliminate the medulla oblongata. An affection of this part, such as could provoke convulsions, would give rise to *tetanic*, not to *clonic*, convulsions; and, in some cases, it would act so powerfully and so directly upon the muscles of respiration, that it would probably in many instances annihilate that process altogether. It is true, indeed, that a certain extent of laryngismus often complicates the epileptic convulsion; but primary disturbance of the medulla oblongata would render laryngismus a constant and necessary accompaniment of the epileptic fit, *which is not the case.*

Primary affection of the medulla oblongata does not explain the early and constant loss of consciousness which is pathognomonic of epilepsy, and which is often its *only* symptom.

Diseased states of the medulla oblongata show themselves in impaired deglutition, in vomiting, in altered rhythm of the respiratory movements, in an abnormal proneness to emotional excitement, but not in impaired intellectual action, nor in any affection of consciousness.

We cannot admit, then, that epilepsy is due to a primary disturbance of the medulla oblongata.

We come next to the Corpora Striata and Optic Thalami. These remarkable ganglia, although intimately connected with each other, are nevertheless very different in structure, and probably, also, very different in function. They are no doubt directly concerned in the development of voluntary motions and of sensation, and their intimate anatomical union is in harmony with the close connexion and interdependence of sensation and motion. They have nothing to do with intellectual operations, and therefore not with consciousness; their functions seem limited to the simple exercise of the will, or to that of the perception of some impression made on a sentient organ. If the corpus striatum or optic thalamus be diseased, you have paralysis of motion or of sensation, or both; but a sound state of intellectual power, and of the consciousness, is quite compatible with extensive disease of both of these organs, provided it does not extend beyond them. Mechanical irritation of these bodies does not produce convulsions, nor does any morbid state of them ever give rise to these disturbances of motion. It is clear, then, that these bodies can no more claim to be the seat of the primary disturbance in epilepsy, than the medulla oblongata.

Has the cerebellum any share in the production of epilepsy? I think we must answer this question in the negative likewise. The cerebellum has no influence on consciousness: the absence of the cerebellum is perfectly compatible with consciousness and a certain amount of intellectual power, and these powers remain intact even where there is considerable disease of that organ. Moreover, mechanical irritations of the cerebellum do not give rise to convulsions.

There remain, then, only two parts of the brain in which we can localize the primary disturbance in the epileptic paroxysms—namely, the hemispheric lobes, and the mesocephale.

I will at once confess that my reflections upon this subject have led me to the conclusion that both these parts of the brain are greatly concerned in the production of the epileptic state, and in the development of the paroxysms. First and mainly, the hemispheric lobes; secondly and consecutively, the mesocephale.

You will bear in recollection that the complete epileptic paroxysm exhibits two features essentially distinct from each other: first, the loss of consciousness; secondly, the convulsions. The loss of consciousness and the other mental phenomena are dependent upon a disturbed state of the hemispheric lobes; the convulsions upon a disturbance of the mesocephale, consecutive to, and derived from, the disturbance of the hemispheric lobes.

There is no point in physiology more clearly made out than that the organ which is immediately active in the manifestation of intellectual operations, is the convoluted surface of the brain, and the fibrous mass connected with it—the hemispheric lobes. Every fact in comparative anatomy points to this conclusion. Experiment confirms it likewise. When the hemispheric lobes are removed from a pigeon, as in Flouren's celebrated experiment, which I have more than once repeated, the animal became a mere living machine, capable only of manifesting the physical phenomena of life, exhibiting no indication of mental operation, nor of consciousness; it fell into the deep unconsciousness of epilepsy.

In all instances where the nutrition of the cerebral hemispheres is disturbed the intellect suffers: you have delirium or a maniacal state; or if the disease be of a kind tending to check nutrient change, or to destroy it, you have more or less sopor.

So, also, inflammatory states of the arachnoid and pia mater covering the convolutions of the brain, disturb the intellectual operations, because they are so intimately connected with the hemispheric lobes, being as it were the carriers of nutrition to them, that the nutrition of these membranes cannot be disturbed without perverting that of the convolutions themselves.

Although it is perfectly true, that the brains of persons dead of epilepsy in its earlier periods, will exhibit, as Foville remarks, "nothing, absolutely nothing, which differs from the normal state," unless they have died in the attack, when the cerebral congestion which exists is, in the words of the same distinguished physician, "a feature, not of epilepsy, but of the state of asphyxia induced by it, and in which the patients have died;" still, in the more advanced stages of the disease, when the patients have experienced many fits, morbid appearances are met with, and these affect the hemispheres of the brain chiefly. You have among the most common, opacities and thickening of the membranes, shrinking of the convolutions, enlargement of the sulci between them, increased subarachnoid fluid, alterations of colour, and consistence of the grey and white matter of the hemispheric lobes. These alterations must be looked upon as the accumulated effects produced by the various paroxysms. Each fit does some amount of damage to the brain: in the interval, the brain recovers itself to a great degree, when a new fit comes on, and new mischief is done; and so the repetition of the paroxysms leaves the brain altered as I have described it.

But, observe, the alterations are not of the cerebellum, nor of the medulla oblongata, nor of the corpora striata or optic thalami—but of the hemispheric lobes.

Bouchet and Cazaurielh, who have conducted an extensive series of researches into the clinical history of epilepsy found these alterations of the hemispheric lobes so frequent in the chronic cases, that they attribute the disease to a chronic inflammation of the cerebral lobes, which determines epilepsy if it affect the white substance, insanity if it affect the grey.

I refer to these researches, not because I believe that the conclusion founded on them by their authors is correct, but because they strikingly indicate that the seat of the organic disturbance (which these authors admit to be *caused by* the fits) is in the hemispheric lobes.

It cannot, I think, under the weight of argument which may be adduced in reference to the office of the hemispheric lobes, be doubted that an affection of these parts is capable of inducing all the phenomena of epilepsy, as far as regards consciousness and sensibility.

But an important question remains: can a disturbed state of the hemispheric lobes induce or excite convulsive movements? The proper answer to this question appears to me to be this:—under ordinary stimulation of the substance of the hemispheres, the fibres are incapable of exciting motion. It is not the office of these fibres to propagate the nervous force to muscles, but to other nervous centres. Their function is to establish communications between the great sheet of vesicular or grey matter which covers the convolutions of the brain, and the corpora striata, optic thalami, and mesocephale, so that changes in any of these centres may be propagated from any one to any other, or to all the rest. Hence the sections and irritations by mechanical and galvanic means to which these fibres have been subjected in the hands of various experimentalists, produce no disturbance of motion, so long as the irritation is strictly confined to them.

So far then, anatomy and experiment denote to us that of themselves these fibres of the hemispheric lobes cannot excite motion, but that they may do so through their influence upon other ganglia of the brain; and such phenomena, as I referred to at the commencement of the lecture, as a convulsive affection of the whole of one side of the body, evidently brought on by the deposition of tubercular matter on the surface of the cerebral hemisphere on the opposite side, and its consequent irritation, show that convulsive movements may be excited by a superficial lesion of the hemispheric lobes.

Hence we must not deny to these lobes a certain power of exciting motion, either directly or indirectly, through their influence upon other ganglia of the brain. But it is important to remark, that the influence of the hemispheres is most manifest for this purpose when the lesion is superficial: that is, when it affects the grey matter. A deposition of tubercle, such as took place in the case I described at the commencement of the lecture, would produce little or no disturbance if it took place in the white substance: it would interrupt the functions of some of the fibres; but when deposited in the vesicular matter, among the particles of the generating plate of the nervous battery, the development of the nervous force becomes seriously impaired.

From all these facts, then, I infer that a disturbed state of the hemispheric lobes may undoubtedly give rise to so much of the phenomena of the epileptic paroxysm as refers to the affection of consciousness and sensibility, and that it may, *in some degree* at least, contribute to the development of the convulsions.

We must not forget that, in forming a theory of the pathology of epilepsy, we have to explain not a continuous state of disturbed sensation and motion, but a malady, the grand feature of which is the *periodical* recurrence of the paroxysms, the patient being wholly or almost restored to his normal state in the intervals between the attacks.

Now, it is not a little remarkable that there is no organ in the body which exhibits the same kind of periodical activity and quiescence in the performance of its functions, *as the hemispheric lobes*. This periodicity is manifest in the phenomena of sleep: throughout life the tendency exists that for a certain period each day the state of sleep comes on—when intellectual acts cease, the will is not exerted, the perceptive powers remain quiescent, the channels of sensation are closed. This tendency is greatest in the early periods of life than at any other time—greatest of all in infancy, when sleep engrosses the largest portion of time: very marked in childhood, less imperious in adult life, but assuming a somewhat increased influence in second childhood—OLD AGE.

It is unnecessary for me to take up time in adducing arguments in support of the assertion, that the phenomenon of sleep belongs to the brain, and especially to the hemispheric lobes: I must content myself with the statement, that the periodical recurrence of sleep is a part of the train of phenomena which belong to the normal nutrition of the brain. The diurnal variations of our planetary system are not more surely influenced by the laws which regulate them than is the brain by that law of its nutrition which enforces that the activity of that part of it which is immediately associated with the operations of the mind should be from time to time interrupted by sleep.

In hybernating animals, we have a remarkable example of the extraordinary influence of this law of the nutrition of the brain, and of the curious mastery which it exercises over all the other processes of life. When the winter sleep sets in, the breathing becomes slow, the circulation is languid, the body feeds upon the store of fat which had been laid up during a period of exertion, the chemical changes of the body are reduced in activity and complexity. It lasts a certain time, and the animal becomes gradually roused, and resumes its wonted place among the active denizens of the world.

We have, indeed, in the animal economy, phenomena in some degree analogous to this alternate activity and quiescence of the brain. The heart beats with a certain rhythm, and pauses after it has accomplished its systole and diastole.

Respiration exhibits a similar rhythm in its movements.

So, also, perhaps, the peristaltic action of the bowels.

Something like a physical explanation of these phenomena may be offered, but we know no physical cause for sleep; and, in the existing state of knowledge, we must rest content with regarding it as an ultimate fact, that it is to the peculiar economy of the brain, and to the laws which specially regulate its nutrition, that we owe the unspeakable advantage and enjoyment of

"Tired Nature's sweet restorer, balmy sleep."

When these laws are impaired, there is either too much sleep, or it is almost banished from the eyes, and nature at length sinks exhausted.

Dr. M. Hall, indeed, thinks that he can derive some physical explanation of the phenomena of sleep from the antagonism which he assumes to exist between what he calls the spinal system and the cerebral system. "As sleep approaches (he says) the levator palpebræ, a muscle of voluntary motion, ceases to act; whilst the orbicularis, a muscle of true spinal action, contracts and closes the eyelids.

"Imagine (he adds) "an event similar in its nature to take place in the muscles of the neck: volition ceasing, spinal action being energetic, certain muscles contract and compress the veins, and a degree of fulness of the neck and face, with turgidity of the eyes, is the obvious result; nay, there is even a degree of laryngismus heard in the respiration. All this is most observed in the first deep sleep."

Now, to pass over certain very decided sources of fallacy in this view, such as the assumed energetic condition of spinal action, the contraction of the orbicularis and other muscles, the distinction between a muscle of true spinal action and of cerebral action, it is plain that it involves a *petitio* *principii*, and this is expressed in the first three words of the passage I have quoted—"as sleep approaches;" and in two words of the succeeding paragraph—"volition ceasing." The whole question is involved in these two phenomena—the approach of sleep, the abeyance of volition: if we can determine what influences the approach of sleep, to what its first beginnings are due, what determines the abeyance of volition, we need inquire no further. According to Dr. Hall's views, the increased energy of the spinal system, to which is due the contraction of the orbicularis and of certain muscles of the neck, is the immediate consequence of the first approaches of sleep, of the beginning of the state of quiescence of the cerebral system. In short, the state of sleep has already begun ere the exciting cause of this contraction of the muscles of the neck is brought into operation.

But to return to the question which we have in hand.

I say, then, that the periodical character of the phenomena of the normal nutrition of the hemispheric lobes of the brain denotes strikingly that these organs have much to do with the primary disturbances which cause those periodical paroxysms which constitute epilepsy.

But there is another part of the brain to which I think we must assign some share in the production of epilepsy.

This is that part of which the corpora quadrigemina form a prominent portion—the upper and posterior part of the mesocephale, the nodus encephali, the connecting medium between the several parts of the encephalon, which is not only anatomically related to all the constitutional parts of that organ, but possesses inherent powers of its own of great and general influence upon the movements of the body.

I have already referred to this part in my last lecture, as being the centre of emotion: as such it is much influenced by mental states; and we know that epilepsy is often brought on by the shock produced by seeing another fall into a fit.

Flourens states, that while superficial sections of the corpora quadrigemina produce no other effect than the impairment or loss of vision, deep sections produce general convulsions.

I have been desirous of ascertaining whether the parts within the cranium, if excited by the stimulus of galvanism, would give rise to any phenomena, similar or analogous to those produced by galvanic stimulation of the spinal cord. Accordingly I determined to subject them severally to the action of the magneto-electric rotation machine,—a most convenient instrument for physiological experiments.

The experiments were performed on rabbits. I took the spinal cord first: here we had the well-known tetanic effects to which I have already frequently referred.

Next I tried the medulla oblongata: the effects of the stimulation of this organ were much the same as those produced by irritating the cord.

I then tried the corpora quadrigemina and the mesocephale. Having passed fine brad-awls into the cranium in such a direction as I had previously satisfied myself would lead to this organ. I subjected it to the influence of the machine: general convulsions were produced, of a character essentially different from those which resulted from stimulating the spinal cord or the medulla oblongata. They were combined movements of alternate contraction and relaxation, flexion and extension, affecting the muscles of all the limbs, of the trunk and of the eyes, which rolled about just as in epilepsy.

On inserting the awls into the hemispheric lobes, still different effects were produced by the application of the machine. I could observe nothing like true convulsions; but slight convulsive twitchings of the muscles of the face took place, which were no more than what would be caused by the stimulus of galvanism acting upon the nerve of the face.

These experiments, which I repeated several times, and each time with like results, seem to denote that convulsions are modified according to the part of the cerebro-spinal axis which is primarily excited: if it be the spinal cord, they are tetanic; if the medulla oblongata, they are tetanic likewise, other parts being involved; if the corpora quadrigemina and the mesocephale, they are epileptic; if the cerebral hemispheres, you scarcely have any convulsions, but slight twitchings of the muscles.

Weber, in his excellent essay on Muscular Motion, published in Wagner's "Handworterbuch," of physiology, refers briefly to similar experiments performed by himself on the brain of a frog, and leading to the same results; and he draws this conclusion, "that the tonic convulsions, as trismus and tetanus, are the effect of disturbance of the functions of the spinal cord; whilst the clonic convulsions are due to derangements of the functions of certain parts of the brain."

Thus, then, I come to this conclusion respecting the parts of the nervous system which are directly concerned in the production of the epileptic paroxysm.

The part of the encephalon primarily disturbed, is the hemispheric lobes; if the disturbance do not go beyond a certain point, the phenomena are limited to loss of consciousness and impaired intellectual action, with more or less of sopor. But if the disturbance be considerable, then the tubercula quadrigemina and mesocephale become involved, and *epileptic convulsions* are produced. If the disturbance of this centre be very great, the medulla oblongata and the medulla spinalis become much excited, and the convulsions are complicated with a good deal of the tetanic character.

We know that there is a great variety in the intensity of the epileptic paroxysms, *i. e.* not only in the intensity and duration of the coma, but also in the violence of the muscular paroxysm: all this depends on the nature and force of the primary disturbance in the cerebral hemisphere, but in all instances the hemispheric lobes are first disturbed, next follow the corpora quadrigemina, and upon the intensity of their disturbance depends the extent to which the medulla oblongata and the spinal cord are engaged.

A question not less important to the determination of a correct pathology of epilepsy than that which we have now discussed, must next occupy our attention. This is, as to the intrinsic nature of the disturbance of the brain in this malady, and the exact organic condition of it which is capable of exciting the epileptic phenomena.

Is it a state of inflammation ? or one of congestion ? or is it a condition the opposite of congestion—one of deficiency of blood ? or, in fine, is it a perverted nutrition, due more to a depraved *quality* of blood, rather than to alterations in its *quantity*, but by no means independent of the latter ?

It is scarcely worth while to occupy time by stating the arguments against the idea of the inflammatory nature of epilepsy. We have now sufficient knowledge of the diseased states of the brain to enable us to recognise that affection when it occurs. Moreover, inflammation does not occur without leaving its traces behind,—and it is impossible that epilepsy could be an inflammatory disease, and leave behind it so little marks of such a disturbance of nutrition, as would leave it in the power of so able and so experienced an observer as Esquirol, to say—" we freely confess that pathological anatomy has hitherto thrown but little light upon the immediate seat of epilepsy." The records of cases of undoubted inflammation of the brain show that epilepsy is not one of its symptoms, whatever part of the brain may have been the seat of the inflammatory process.

It may next be asked, is epilepsy caused by a state of congestion of the brain ? This is a favourite notion with many ; nor can one wonder that it should be so, when we consider how exclusively of late years the attention of pathologists has been directed to the state of the solids, and how often they have failed to find any indications of morbid change, save such as are due to a greater or less amount of blood in the blood-vessels. It has been the prevailing tendency to look for congestion of blood, and to rest content with it as the cause of the phenomena during life, the observer all the while overlooking the important inquiry, as to the period of the occurrence of the congestion ; whether it might not have occurred in the mortal agony,—whether, indeed, it could fairly be regarded as having taken place during life,—or whether it might not be a post-mortem appearance.

But what does morbid anatomy teach us on this point ? Why, that congestion is far from being a constant appearance in the brains of epileptics,—that its presence is mainly influenced by the mode of dying of the patient,—that in a large number of cases there is rather a deficiency than a superabundance of blood in the brain,—and that when congestion of the brain does occur in epilepsy, it may be looked upon rather as the consequence of the paroxysm than as its cause, the paroxysm being such as, by the mechanical interference which it creates with respiration and with circulation, greatly retards the return of the blood from the brain—as from all other parts—to the right side of the heart.

Furthermore, it may be now confidently affirmed, as pointed out by experience, that a state the opposite to that of congestion—namely, a state of *anæmia*—is favourable to the occurrence of epilepsy ; and the convulsions of children and those of lying-in women are frequently brought on from anæmia due to imperfect nutrition in the former, and to excessive floodings in the latter.

The following case—and my experience has supplied me with several similar—is a striking instance of the extent of disturbance likely to arise from great loss of blood :—

A married woman, aged 30, was admitted into King's College Hospital, in January 1849. Two years ago she had a miscarriage after a pregnancy of three months. In August 1847, she was delivered by instruments of a dead child. In June 1848, she again became pregnant, and, after having gone two months, she miscarried, without excessive hæmorrhage. From this time her health began to fail—she became low and desponding—and made no blood ; looked pale and thin.

On the 28th of last December, having been some time in a state of great weakness, she suffered from giddiness of head, and became slightly delirious. For these symptoms she was bled from the arm, and had leeches applied to her head, and a blister to the back of her neck. The next day, the symptoms remaining unaltered, six leeches more were applied to her head. While these were yet drawing, she gave a slight scream, and fell forwards in a fit of convulsions, during which the orifice in the vein burst open, and a good deal of blood was lost.

On the 30th of December, while six leeches more were being applied to her head, she had a second fit, exactly resembling the first, and during this the orifice in the vein in the arm again opened, and more blood was lost.

On the 3rd of January she had a third fit, which lasted about one hour, and on the following day she had two fits. She now became maniacal, but controllable, and in this state, exhibiting all the signs of extreme anæmia, she came into the hospital.

Here, then, is a remarkable instance in which a state of extreme anæmia—the practice of general and of local depletion—offered no protection against the epileptic state : might we not say that an opposite mode of treatment, one adapted to improve the blood both in quantity and quality, would, in all likelihood, have saved the poor woman from the fits of epilepsy, and from a prolonged state of chronic mania under which she afterwards suffered ?

Dr. Marshall Hall attributes much of the phenomena of epilepsy to vascular congestion. He has put forward the following theory of epilepsy. He says :—" 1. Some source of irritation, acting in a reflex or direct manner, excites the spinal system. 2. Contraction of certain muscles of the neck; compression of the veins, and congestion of the cerebrum, with cerebral symptoms—cerebral epilepsy—are the consequences. 3. Then follow laryngismus, with every formidable convulsive symptom, spinal epilepsy, and congestion of the encephalon in a tenfold degree, with all its dire effects on the intellect and on the limbs."

Admitting, as I do, the great ingenuity of this theory, I cannot accept it as a correct explanation of the phenomena of epilepsy, or as adequate to explain the various and complicated symptoms of that malady.

Without discussing any further the question whether congestion of the cerebral bloodvessels can excite the epileptic paroxysm (a question, I think, answered in the negative by all reason and experience,) there are two points which need to be proved in the most unequivocal manner before this theory can be admitted as adequate to explain the phenomena of epilepsy.

The first is, that contraction of the platysma and of certain muscles of the neck can cause congestion of the veins of the neck, and consequently of the head. Upon this point I confess that I can come to no other conclusion than that the anatomical disposition of the platysma unfits it to act as a compressor of the veins of the neck. If by its contraction it exercises any influence upon the venous circulation, especially the deep-seated veins, it would rather tend to protect them from the pressure of the super-incumbent tissues. When the platysma myoides is strongly contracted, the hollow of the neck is obliterated, the teguments are raised up, and they are rendered tense between the clavicle and the jaw. To effect such contractions of this muscle, which is not so completely under voluntary control as some others, requires considerable effort, and the simultaneous contraction of other muscles. This effort, by impeding respiration in some degree, tends more or less to congest the veins of the head and neck: but I have seen strong contraction of the platysma on both sides kept up for a considerable time without inducing any amount of congestion which would attract notice unless the attention was particularly called to it. In slight or partial contractions no such congestion occurs, and it is still less likely to take place in any contraction which might be caused by reflex action, in which there is no effort whatever on the part of the individual.

A second point, which needs proof, is the connection between *laryngismus* and convulsions. This connection, according to Dr. Hall's views, is so intimate, that the former is a necessary precursor of the latter. In other words, it may be said that convulsion of the laryngeal muscles must precede that of the other muscles. Surely such a view as this is untenable. There cannot be any necessary connection between the convulsion of the laryngeal muscles and that of the other muscles supplied by cerebro-spinal nerves, so that convulsions of the one should necessarily precede that of the other. All muscles are equally exposed to the cause which excites the paroxysm; if that cause excite only one side of the brain, the muscles on the opposite side of the body are thrown into convulsion. And although we sometimes find that one set of muscles will take precedence of another in convulsions, there is no constant rule to determine what muscle shall be first convulsed, and especially that precedence does not belong to the laryngeal muscles.

I have ascertained, by direct experiment, that general epileptic convulsions may take place when laryngismus, which is the chief cause of the impediment to the venous circulation, and of the subsequent cerebral congestion, cannot occur.

I looked for some poison which was capable of exciting epileptic convulsions. Although the Œnanthe crocata is stated by Toxicologists to have this power to a remarkable degree, I was unable to produce the effect in dogs with either large doses of the expressed juice of the root or with large quantities of a strong decoction of the roots. I therefore had recourse to Hydrocyanic acid, which developes the epileptic state in a very marked manner.

The first experiment was upon a large dog. A free opening was made in his trachea, so that inspiration and expiration were performed with the utmost freedom. The dog was then poisoned by Prussic acid. In a short time epileptic convulsions of the usual character, complicated with a good deal of spinal convulsion, ensued.

In the next experiment I proposed to divide the recurrent nerve on each side, and thereby to paralyse the constrictors of the glottis. Although the division of one of the nerves was not affected, the other was effectually cut across, and a large piece cut out of it. The voice of the animal was destroyed, and, as the muscles on one side were paralysed, it was obvious he was quite as unable to close the glottis completely as if the muscles were paralysed on both sides. Hydrocyanic acid was then administered, as in the first experiment, and very complete convulsions were very shortly developed, the eyes being very much affected, and all the muscles of the trunk and extremities.

The third experiment consisted in tracheotomizing a dog, and introducing a large tube into the trachea, which insured a greater freedom of inspiration and expiration than when there was only a simple opening. The administration of Hydrocyanic acid was followed by the same distinctly epileptic general convulsions as in the two former instances.

Undoubtedly in all these experiments, especially in those in which an opening was made in the trachea, there was less impediment to breathing, and less venous congestion; but, notwithstanding this, the epileptic state was fully developed under the influence of the poison. A free opening in the trachea, and the prevention of the consequences of laryngismus, did not prevent convulsions from taking place.

Thirdly. We may ask, is epilepsy due to an anæmic state of the brain,—to an imperfect supply of blood to that organ?

Although I cannot admit that epilepsy is commonly due to an anæmic state of the brain, still I must say that there are more facts in favour of this view than of the congestive theory, and that an imperfect supply of blood to the brain is very often associated with the epileptic condition.

I have already referred to cases in which epilepsy had supervened upon an anæmic state. These might be multiplied considerably, did time permit. What is particularly deserving of attention is the class of cases where convulsions ensue upon excessive uterine hæmorrhage,—cases long recognised by the most experienced obstetrical physicians.

A cachectic state, in which the red particles of the blood are only very imperfectly developed as to quantity, is very apt to accompany epilepsy. We see this frequently in hospital practice, in a very hard-working class of men—compositors in printing-offices, especially in those of newspapers. These men frequently work all night; and, to support them in their toil, they addict themselves to the frequent use of spirits or other fermented liquors. General nutrition fails: the red particles are imperfectly regenerated, and the patient becomes epileptic.

Patients labouring under chronic disease of the kidney are much more apt to become epileptic, if they are pale, and if their blood is deficient in its red particles.

House-painters, or others exposed to the contamination of lead, are apt after some time to fall into a fearfully cachectic state, of which a principal feature is the deficiency in the red particles of the blood. I have seen several persons, under these circumstances, become epileptic shortly before death, and, in fact, die in consequence of the violence of the epileptic paroxysms.

All these are striking instances to show how blood, deficient in quantity,—deficient in one of its most important staminal principles (the others, perhaps, not being quite normal,)—and, perhaps, contaminated by the presence of some foreign noxious principle,—is favourable to the production of the epileptic state.

Experimental physiology supplies us with very striking facts to show that an insufficient supply of blood to the brain is very apt to occasion epileptic convulsions.

Every one who has witnessed the slaughter of sheep, which is effected by dividing the great arteries in the neck, must have observed the strong convulsions which so frequently precede death in animals killed in this way. All animals killed by loss of blood exhibit the same phenomena precisely, and die with convulsions of a more or less violent kind.

Dr. Seeds many years ago performed a series of experiments to observe the phenomena accompanying the deaths of animals by loss of blood. In all the cases convulsions preceded death.

In Sir Astley Cooper's experiments, by the application of ligatures to the carotid and vertebral arteries, the functions of the encephalon seemed more influenced by occlusion of the latter than of the former arteries. A considerable portion of the blood of the carotids is distributed to the external parts, to the membranes, to the parietes of the cranium; and those branches which supply the brain anastomose very freely with the vertebral arteries.

When the vertebral arteries were tied or otherwise obstructed, the carotids having been previously tied, very serious symptoms ensued; a state of insensibility was induced, which frequently was accompanied with convulsions, affecting the muscles of the eye-balls, as well as those of the extremities. In one experiment the carotids of a rabbit were tied, without any material effect. In five minutes the vertebral arteries were compressed by the thumbs, the trachea being completely excluded. Respiration stopped almost directly; *convulsive struggles* succeeded; the animal lost its consciousness, and appeared dead. The pressure was removed, and it recovered, with a convulsive inspiration.

On a second compression of the vertebrals, similar phenomena ensued.

Three times more the compression of the vertebrals was repeated, with like result. On the fifth occasion, says Sir Astley, the result was the same—namely, suspended respiration, convulsions, loss of motion and consciousness.

These, surely, are symptoms very closely resembling those of epilepsy.

It is much to be regretted that Sir Astley's experiments on tying the jugular veins were not more numerous. Only two are recorded. In one, after ligature of both jugular veins, the respiration was reduced in frequency to about half the usual number for a few hours, and the animal recovered without any other untoward symptom. In a second, the same reduction in the frequency of the breathing ensued upon the application of the ligatures: for five days the animal seemed dull, and on the seventh day it became convulsed, and frequently rolled over, and lost its voluntary power and its sensation in a great degree. But these symptoms, it was proved after death, were due to the extravasation of a clot of blood in the left ventricle of the brain.

The application of ligatures to the jugular veins, so as to impede the return of venous blood from the brain, is evidently, so far as these experiments go, productive of less serious consequences than the cutting off the supply of blood to the brain.

But we do not need experiments to prove what an enormous extent of congestion the brain can bear without inducing anything like an epileptic state. Look at cases of old asthma, with dilated right side of the heart, and large jugular veins, into which the blood freely regurgitates at every systole of the auricle; witness, also, the excessive congestion which accompanies severe suffocative catarrh, chronic bronchitis, and some of the complications of phthisis which are attended with great dyspnœa. If congestion of the brain were the common or even frequent cause of epilepsy, that malady ought frequently to accompany the disease above named: yet patients labouring under these complaints, although they often become comatose shortly before death, seldom exhibit anything like convulsions, nor anything of a genuine epileptic state.

I come, therefore, to this conclusion,—that while it is highly improbable that a state of congestion *per se* gives rise to the epileptic paroxysms, it is extremely probable that the opposite state, one of anæmia, or of imperfect supply of blood, does frequently cause the complete epileptic fit, and that such a state is much more to be feared and guarded against by practitioners than the state of congestion, not only because its consequences are more serious and more persistent, but also because they are much less amenable to the remedies within their reach.

At the same time, this state of anæmia is not in itself the cause of epilepsy. We have too many instances of epileptics in whom no indication of an anæmic state exists, to allow the admission that the influence of anæmia operates in any other way than as one of the most potent disturbers of the nutrition of the brain; and we are therefore led to class it with other causes of disturbance which interfere with and derange the normal nutritive processes of the brain, giving rise to irregular actions of certain of its parts.

Having freely discussed the more obvious disturbances of the circulation in the brain which have been and are set down as productive of the epileptic state, it remains for me to develope a theory of epilepsy such as seems most in accordance with our knowledge of the physiology and of the pathology of the brain.

I would lay it down that epilepsy denotes a state of abnormal nutrition of the brain.

This abnormal nutrition shows itself in the unnatural development of the nervous force at particular times, in such a manner as to disturb the functions of the whole cerebro-spinal centre, but of the brain in particular.

These periodical evolutions of the nervous force which gives rise to the complete epileptic paroxysm, may be compared to the electrical phenomenon described by Faraday, under the name of *disruptive discharge.*

We know that this phenomenon requires for its production, first, a highly charged or polarized body, which, when it reaches a certain point of tension, may be made instantaneously, and with violence, to discharge its electricity to a conductor.

Thus the abnormal nutrient actions of the brain in epilepsy, tend to produce a polar state of the particles of the Hemispheres, of the Tubercula Quadrigemina, and of the mesocephale, which, when it reaches a certain tension, discharges itself, and induces with great violence a rapid polarization of the neighbouring particles, involving in the general disturbance the medulla oblongata, the cerebellum, and the spinal cord.

In some instances the tension may be limited to the hemispheres of the brain,—then consciousness and intellectual action only are disturbed; either a comatose state is induced, which lasts for a certain time, or mania or delirium are produced. In such cases the state of tension may pass off slowly and gradually without any distinct discharge, and so the nervous matter may assume a state of equilibrium, without creating any serious disturbance of the other parts of the cerebro-spinal centre. In other cases the hemispheres and mesocephale pass quickly to the highest degree of tension, and a rapid discharge takes place, exciting the other parts of the brain and the spinal cord, with all the violence of the discharge from a highly charged Leyden jar, or the shock from the electrical organs of the torpedo or gymnotus.

The gradual and silent manner in which this state of tension is induced in the brain, and the absence of all appearances of mischief recognizable by our means of investigation in recent cases, the rapidity with which fit succeeds fit in the acute cases, leaving likewise no trace of organic mischief, denote that the peculiar state of the brain in epilepsy is brought on not by any change in the quantity of the blood, but by the accumulation of some material in the blood, which, acting on the brain as a poison, excites this polar state, and this disruptive discharge, and so escapes from the system, leaving the brain free from disturbance until a fresh accumulation excites a new paroxysm. The same comparison may be used here as I have already employed in speaking of other convulsive diseases. The nervous battery is excited by an abnormal fluid,—a fluid which causes it to develope the nervous force in irregular quantity,—a fluid which, when fully charged with its particular morbid element, excites a high degree of tension of the cerebral nervous matter, which can recover itself only by a discharge, which produces more or less serious disturbance of the neighbouring parts of the brain.

Under this view the infinite variety in the character and violence of the epileptic fits would be accounted for by variety in the quantity of the morbid material which contaminates the blood,—the poison which disturbs the normal actions of the brain,—by the different intensity with which it affects one part more than the other,—the comatose symptoms, being the more developed as the cerebral hemispheres are affected,—the convulsive symptoms, when the chief disturbance, is in the mesocephale,—and, perhaps, also by difference in the quality,—the virulence—of morbid element.

This humoral doctrine of epilepsy is supported by a host of striking facts. The influence of certain poisons—as Prussic Acid and Œnanthe Crocata—in the production of artificial epilepsy, the exact counterpart of the disease as it affects the human subject, is one of the most important of these. Saillant, a writer in the memoirs of the French Royal Society of Medicine (ann. 1782-83,) concludes a paper detailing some experiments on the artificial production of epilepsy, with these remarks:—"We are content with concluding that it is easier to produce an artificial epileptic paroxysm through the blood than by irritation of the brain and nerves." Saillant's experiments consisted chiefly in injecting air into the veins.

A second class of facts, bearing most strongly on this view of the nature of epilepsy, is the frequent connexion between this disease and imperfect eliminatory action of the kidney, a connexion which I have no doubt ere many years we shall find to be very much more frequent than is even now suspected.

Nay, a temporary functional suppression or deficiency in the secretory action of the kidney, would allow the urea, and perhaps certain other elements of the urine, to accumulate in the blood to such an extent as to exert a poisonous influence on the brain, and to develope the epileptic paroxysm. The fact, first I believe brought to light by Dr. Lever, that the urine of women who have suffered from puerperal convulsions is sometimes albuminous, suggests that in some of the patients who suffer this form of epilepsy the disease may be referred to defective action of the kidney. This point, however, has yet to be worked out, and when physicians come more generally to look for the causes of morbid phenomena in something beyond mere excess or deficiency of blood, we shall probably obtain some satisfactory elucidation of it.

A third class of facts favourable to this view is derived from the diseases confessedly humoral, and the paroxysmal character which they are apt to assume. I would allude more particularly to the effects of the paludal poison, and to gout. Under the influence of the former, we have periodical paroxysms almost convulsive in their nature. A severe fit of ague in its cold stage is not far from an epileptic convulsion. The marsh poison, whatever be its dose, shows its effects in regular periodical paroxysm; the poison accumulating in conjunction with certain nutrient changes in the blood, reaches the quantity necessary to produce a paroxysm only at certain periods. The introducting of quinine checks this regenerating or cumulative power of the poison, and ultimately kills it. In gout we have an analogous tendency to the accumulation of the poison so as to occasion paroxysms. The regular development of the gouty paroxysm at the spring and fall of the year in some individuals, and its frequent occurrence at short intervals for a certain time, as once a month or once in two months, are phenomena analogous to the periodical development of the epileptic paroxysm.

Lastly, we have the very important fact, that certain animal poisons, as that of small-pox, measles, scarlet fever, or even the poison of typhus, may, on their introduction into the system, produce epilepsy.

Of the *nature* of the morbid matter, which, by its accumulation in the blood, may produce the epileptic paroxysms, no conjecture can be formed in the present state of our knowledge. It may, perhaps, vary in different cases: in the renal cases, for instance, it may consist merely of certain retained elements of the urine. Of these, the experiments of Dumas and Prevost point chiefly to urea as the most highly poisonous; but I apprehend this point needs further investigation. In the ordinary cases we may assume that the morbid matter is some subtle agent, possessing properties allied to those of prussic acid, whose chemical nature may yet, in the progress of chemical analysis, be ascertained.

What are the sources of this morbid matter? I apprehend the most common source is the brain itself. The frequency with which epilepsy follows undue exhaustion of the nervous power, from anxiety, grief, long-continued thought, habits of intemperance—mental, as anger, rage, despondency,—physical, as the indulgence in ardent spirits or other fermented liquors. The influence, too, of mental shock, in the production of the epileptic state, must be regarded as denoting that direct disturbance of the nutrient actions of the brain under mental influence, may operate as a primary exciting cause of this malady.

Now all these causes tend directly to impair the nutrition of the cerebral matter. We have no difficulty in understanding that overwork or underwork (if I may use the word) of a muscle may impair its nutrition, and so weaken its powers. But we do not attribute this to an over supply of blood, or to an insufficient supply. The excessive or the imperfect exercise of the muscular force affects the tissue itself, impairs the nutrient changes which take place in it, disturbs the attraction between the blood and the tissue, and perhaps alters the nature of the material which is formed out of the effete particles, in what Dr. Prout calls the destructive assimilation of the tissues. Just in this way the nervous matter suffers in the first instance from excessive or perverted use, the nutrient changes are impaired, and the secondary processes of assimilation generate a material which becomes a source of contamination of the blood.

No doubt, however, there may be other sources of contamination,—the digestive organs, the sexual organs, the great glands,—which may not only generate morbid matters capable of contaminating the blood, but may, by the imperfect performance of their function, weaken or otherwise damage the nutrient changes of the nervous matter, so as to make it more susceptible of the influence of any noxious agent, or to cause it to generate a morbid matter.

Where there is hereditary taint, the inherited tendency is to the generation of what I might call the epileptic morbid matter under the influence of any cause which may disturb general nutrition, or impair the local nutrition of the encephalon.

Such is the theory of epilepsy which appears to me most consistent with the known facts of the clinical history of the disease, and with the general principles of physiology and pathology.

That it is sufficient to explain the ordinary cases where attack succeeds attack with more or less of periodical regularity, is obvious; this periodicity being explained partly by the periodicity of the normal actions of the brain, and partly by the re-accumulation after certain intervals of the morbid or poisonous matter. Nor is it inconsistent with this view that at the expiration of each of these periods the patient should experience not one, but a series of epileptic attacks in rapid succession, the number and violence of the attacks being determined by the quantity of the poison and its virulence, and, in some degree, perhaps, by the state of excitability of the nervous system.

Many instances occur where men have had but one epileptic attack during a long life. Are these cases explicable by this theory? Such cases may rank with the puerperal cases, or with the convulsions of children. They are due to some rapid change in general nutrition when the nervous system is in an excitable state. They are often caused by a debauch, excessive indulgence in the pleasures of the table, or of some other kind, which at once excites the nervous system and disturbs general and local nutrition.

An interesting question which I have found it convenient to postpone until now, is as to the validity of that distinction which I admit is useful for practical purposes, into *centric* or *eccentric* epilepsy.

Under the theory which I have just enunciated, all epileptic cases are strictly centric—that is, result from a cause acting directly upon the centre. But may not the cause originate at the periphery, and act upon the centre through incident nerves, affecting the brain through the spinal cord? To this question I think I must answer in the negative. Evidence is wanting to prove that the peripheral irritation of nerves is capable of exciting the epileptic paroxysm. You remember the remarkable conclusion of Saillant, which I have quoted above, "that it is easier to produce an artificial epileptic paroxysm through the blood, than by irritation of the brain and nerves." Then I may be asked, what becomes of the cases so generally admitted, in which epilepsy is caused by worms in the intestinal canal? in which, if you expel the worms, you cure the epilepsy. I am not prepared to deny the occasional association of worms and epilepsy, nor their connexion as cause and effect; but I would affirm that worms cause epilepsy not by direct irritation of the intestinal nerves, the spinal cord, and the brain, but by the disturbance of nutrition which they keep up. The mere presence of worms in the intestinal canal is an indication of deranged secretions there, and of a disturbance of its nutrition: worms do not flourish in a perfectly normal state of the intestinal canal. Therefore we may lay it down that there has been a disturbance of nutrition prior to the appearance of the worms, which is kept up and increased by the presence of the worms.

Another question connected with this subject appears to me deserving of consideration. Can permanent unchanging chronic disease of the encephalous or of the cranial wall, be regarded as capable of causing the epileptic fits? Take, for example, such a case as the following:—A man has been epileptic for many years of his life, and his malady has resisted various remedies. He dies, however, of some other disease. On inspection, the brain is found healthy, but about the centre of the falx there is a tumour as large as a small walnut. Has the tumour been the cause of the epileptic attacks in this case? I incline to say No to this question, because such tumours are of very slow growth, and we know that the brain adapts itself wonderfully to the extension of such morbid productions upon the space in which it lies,—because such tumours have existed without epilepsy,—because a cause in constant operation is not likely to produce an occasional effect. At the same time I think it must be admitted that a man with such a tumour is more liable to be epileptic under states of general or cerebral disturbance, than a man whose brain and its membranes are healthy, because the presence of such a tumour scarcely admits of the nutrition of the brain being perfectly normal.

Epileptiform attacks are apt to be produced by meningeal irritation, as I have already pointed out. Under frequency of repetition, and the consequent increased cerebral disturbance, these attacks may become epileptic; and this is the more apt to occur if there be any constitutional malady,—if the local mischief originate in any constitutional taint. Thus scrofulous deposits in the membranes will readily give rise to fits, at first epileptiform, and finally epileptic. And cases of the following kind are not uncommon:—A man contracts syphilis; some time afterwards, with or without other secondary symptoms, he gets periostitis of the tibia, or of some other long bone; at length he has an epileptiform attack, or it may be an epileptic fit; and now it is discovered that some part of the pericranium is painful, and there is good reason to believe that the dura mater is affected: there is periostitis within the cranium. Many of these cases do well under the judicious combination of iodide of potassium and mercury, or under the use of the former remedy only.

So, also, injuries of the head, proving after the lapse of a longer or shorter time injurious to some part of the osseous wall of the cranium, seem to cause epilepsy, and are more especially likely to do so if any derangement of general nutrition occur,—gout or struma, or the syphilitic taint. Perhaps in some of the cases epilepsy would have shown itself, even though no injury had taken place. How many hundreds of instances are there where injuries of the head, even of an extensive kind, have occurred, without a sign of epilepsy!

The terms *centric* and *eccentric* are so far useful as directing attention to the *source* of the depraved nutrition of the brain; but epilepsy is always the result of such depraved nutrition, and it is highly improbable that it can ever be looked upon as produced by reflex action—that is, by a peripheral irritation propagated to a centre, and exciting great irritation there, involving spinal cord, and motor and sentient nerves.

I shall conclude with a few remarks upon the treatment of epilepsy.

If much obscurity hangs over the pathology of this malady, we cannot wonder that our attempts to treat it have received so little encouragement.

One point of peculiar difficulty as regards the some future period, to lay my results in a detailed form before my professional brethren. Perhaps some other anæsthetic may be found better suited to epilepsy than chloroform. I am not without hope that some anti-epileptic agents—valerianic acid or valerianates—may be more efficaciously administered through the inhalation of chloroform than by the mouth. Mr. Savory, of Bond Street, has sent me some specimens of valerianates held in solution by chloroform; but whether these substances will volatilize with the chloroform so as to admit of their introduction into the system in sufficient quantity, I have yet to learn.

I need scarcely remark, and yet I feel that I ought not to conclude without doing so, that chloroform must not be used without some careful precautions. One cardinal point is, that in its administration atmospheric air should be at the same time allowed to be freely inhaled: another point is, that the administrator should not be eager to obtain a rapid effect, although he should aim at obtaining a full effect; a third, that the recipient should always be placed, during the administration of the vapour, in the horizontal posture; and, lastly, the practitioner should abstain from administering it in feeble cases, where the heart is diseased or feeble, and the circulation languid or otherwise disturbed: and in all cases he should bear in mind that chloroform is a very depressing agent, and he should provide accordingly.

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